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Public School Teacher Cost Differences Across the United States

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Foreword

Most educators readily acknowledge that school districts in different geographic locations encounter different costs in acquiring and retaining similarly qualified teachers. Teacher salaries reflect not only the cost-of-living in a geographic labor market, but also a school district's preference for teachers who are better educated or more experienced. In this sense, reported teacher salaries are similar to reports of median housing value for a school district. The houses may be vastly different in one school district than another (larger square footage and residential acreage, more baths, garages, and the like) and that, as much as geographic cost-of-living, accounts for the differences in median housing value. What one wishes to know is the median price of a comparable house in different geographic locations. Similarly, educators wish to know how much more or less it costs in different geographic locations to recruit and employ school personnel with similar characteristics into similar jobs and job assignments. Accurately measuring such geographic cost differences has been one of the pre-eminent measurement challenges in education.

This study draws on a sample of over 40,000 public school teachers who responded to the National Center for Education Statistics Schools and Staffing Survey (SASS) for school year 1990–91. The research seeks to extend the analysis of teacher compensation to include not only variables which reflect the geographic cost-of-living, but also the amenities of the labor markets in which the public school districts are located. In economic terms, these are "hedonic" considerations. Hedonic attractions of geographic areas may be readily thought of as what attracts workers to an area, be it seashore or skiing resort, major metropolitan area, or rural college town. Of course, such amenities (or disamenities, such as long, severe winters) are beyond the control of a school district, as is the cost-of-living or the competitiveness of its labor market. The research analysis, however, must incorporate all of these considerations simultaneously. The result of the work is an estimated average teacher salary cost index for each state and for regions in each state, which is compared to other frequently used geographic cost adjustments, as well as to unadjusted reports of average teacher salaries.

This publication is classified as both an analysis report and a methodology report. As do most analysis reports, the research yielded extensive information regarding the impact of school district discretionary practices, such as hiring teachers who are better educated or more experienced, and the effect of those discretionary actions upon teacher salaries. However, the research also extends the methodology used to obtain teacher salary geographic cost indexes. In this sense, it is also a methodology report that applies the hedonic methodology to a national data base. The reader is cautioned that this work is developmental and is intended to promote the exchange of ideas among researchers and policymakers. Readers wishing to comment on the study should direct their comments to:

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Executive Summary

Introduction

Since the mid-1970s, a number of studies have been directed toward the development of methodologies and empirical estimation of a cost-of-education index (CEI).[1] A CEI is designed to adjust for differences in the purchasing power of the educational dollar in different jurisdictions. Because personnel expenditures account for about 80 percent of local school budgets, most of the previous studies of education cost differences have focused attention on the analysis of personnel costs.[2] The studies of personnel cost differences address the following question:

> *How much more or less does it cost in different jurisdictions to recruit and employ school personnel with similar characteristics into similar jobs and job assignments?*

The purpose of the present study is to address this question specifically for the most important school input; namely, classroom teachers.

Until recently, no national data have been available to support a comprehensive analysis of the variations in teacher salaries. With the advent of the Schools and Staffing Survey (SASS), conducted every 3 years beginning in 1987–88 by the National Center for Education Statistics (NCES), a data source has emerged that supports the empirical analysis required to develop a national, geographical teacher cost index (TCI). Because teachers represent a substantial portion of the budgets of schools, the availability of this TCI would be a major step forward in the development of an overall cost-of-education index (CEI). The present study draws on a sample of over 40,000 public school teachers derived from the SASS database to conduct the statistical analysis of teacher compensation and cost. Data from the Census Bureau and other sources are utilized in conjunction with the SASS database to complete the analyses.

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[1] See Chambers (1981a, 1981b) for methodological discussions. See Chambers and Parrish (1984) and Chambers (1978, 1980b) for a comprehensive empirical study of educational cost differences. For work of other authors on the CEI, see Augenblick and Adams (1979); Brazer (1974); Grubb and Hyman (1975); Kenney, Denslow, and Goffman (1975); and Wendling (1979).

[2] The estimate of 80 percent of budgets allocated to personnel is derived from the NCES publication *Public Elementary and Secondary State Aggregate Data, for School Year 1990-91 and Fiscal Year 1990* (NCES Report No. 92-033). Table 12 of this report (p. 22) displays total employee expenditures including salaries and benefits at $150 million. Total current expenditure of 187.4 million is reported in table 8 (p. 18). Percentage of current expenditure allocated to school employees is 80 percent (=100 x 150.0/187.4). In fact, since some portion of the remaining 20 percent of school district budgets is allocated to personal service contracts (e.g., psychological services, physical and occupational therapy, consultants, repair services, and legal services), expenditures allocated to personnel actually exceeds 80 percent.

The Importance of Cost-of-Education Adjustments

The importance of developing a CEI is that it may be used in two significant ways. First, it may be used to adjust educational expenditure or teacher salary data for differences in the purchasing power of the educational dollar in different communities. For the most part, published information on education expenditures and the salaries of school personnel across states and other local jurisdictions is based on actual reported values.[3] However, because of the existing variations in the costs of comparable educational resources across state and local jurisdictions, it is difficult to make comparisons of the level of educational services being provided in different locations. In order to make such comparisons of real educational services, it is necessary to adjust reported data on average educational expenditures and teacher salaries for differences in the purchasing power of the educational dollar across jurisdictions.

Second, in addition to their importance for reporting expenditure and salary data, such cost adjustments in education play a significant role in analyses of the demand for educational services and resources across communities.[4] Studies of educational resource allocation have commonly had to resort to using such measures as average teacher salaries or other proxy variables (e.g., opportunity wages in other occupations) to reflect relative costs of school resources. Unfortunately, variations in average teacher salaries reflect both variations in costs as well as the qualifications of the teaching staff. In this kind of analysis, what is required is an index of the relative cost of comparable teachers. The importance of accurately controlling for costs in these analyses is that ultimately such studies are often focused on addressing the impact of changes in state or federal policies or funding formulas. Without the ability to control for the impact of resource costs on choices of local school district officials, it is not possible to isolate the effects of state and federal policies on patterns of resource allocation in local schools.

Toward the Development of a TCI

As the next step beyond using average teacher salaries, Barro (1992) developed a model that adjusts the variations in average teacher salaries for variations in the levels of education and experience. Other researchers (e.g., see McMahon and Chang 1991) have suggested utilizing a *cost-of-living* adjustment to account for the variations in the purchasing power of the education dollar. Unfortunately, neither of these alternatives is adequate. To capture such variations in teacher costs requires a comprehensive analysis of the patterns of teacher compensation. It requires a model that portrays the complexities of the employment transaction between an individual teacher and the school district: that is, one that accounts for school district preferences for teacher qualifications and individual teacher preferences for working and living conditions in local communities.

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[3] For example, see the publications of the National Center for Education Statistics (NCES) on the *Public Elementary and Secondary State Aggregate Data, for School Year 1990-91 and Fiscal Year 1990* (NCES Report No. 92-033).

[4] Examples of studies of the demand for educational expenditures and demand for educational resources (e.g., staff/pupil ratios) at the local level include Barro (1974), Chambers (1975 and 1979), Feldstein (1975), and Ladd (1975).

The *hedonic wage model* provides such a comprehensive conceptual framework for understanding and sorting out the various factors that underlie variations in the patterns of teacher compensation. This model is well suited as a tool to isolate the impact of regional amenities and costs of living on teacher salaries while controlling for various teacher and job characteristics.

In an earlier paper, Chambers (1981a) described the hedonic wage model as follows:

> *The intuitive notion underlying this theoretical structure is that individuals care both about the quality of their work environment as well as the monetary rewards associated with particular employment alternatives, and that they will seek to attain the greatest possible personal satisfaction by selecting a job with the appropriate combination of monetary and non-monetary rewards. Similarly, employers are not indifferent as to the characteristics of the individual to whom they offer particular jobs. The result of these simultaneous choices is the matching of individual employees with employers. It is the result of this matching process itself that reveals implicitly the differential rates of pay associated with the attributes of individual employees and the working conditions offered by employers. More formally, it is the supply of, and demand for, individuals with certain personal attributes to any particular kind of job assignment that determines the equilibrium wages of labor as well as the implicit market prices attached to the personal and job characteristics.*
>
> *The implicit relationship observed between wages and the personal and job characteristics of individuals is referred to as a hedonic wage index. The word hedonic literally refers to the physical and psychic pleasures that one can derive from engaging in certain activities. In the context of labor markets, the word hedonic refers to the satisfactions or utility derived by employees from the characteristics of the work place and the profits or the perceived productive value derived by employers from the characteristics of employees they assign to certain jobs. The hedonic wage index permits one to decompose the observed variation in the wages paid to labor into the dollar values attached to each unit of the personal and workplace characteristics (p. 51).*

Ordinary least squares regression is utilized to estimate the parameters of the model. The estimated coefficients provide a foundation for determining the wage premiums (positive or negative) associated with particular personal, job, or locational characteristics.

Objectives of the Present Analysis

The TCI analysis presented here accomplishes three objectives. First, the TCI component extends the analysis of teacher compensation to include specific variables which reflect the costs of living and the amenities of the jurisdictions and regions in which public school systems are located. Second, the empirical analysis of teacher compensation is used to estimate an average TCI for each state. Finally, the dataset developed for this analysis is used to estimate a regional- as well as district-level TCI for every school district in the country.

The Discretionary Factors: The Effects of Teacher and Job Characteristics on Patterns of Variation in Teacher Salaries

The patterns of teacher compensation across local school systems are ultimately a reflection of a multitude of supply and demand decisions made by potential teachers and their employers—namely public school systems. The level of compensation is the metric by which economic value is conveyed, and it provides the information needed to measure and compare the trade-offs between and among different teacher and job characteristics. The TCI is designed to reflect variations in teacher salaries associated with factors that are outside the control of local school decisionmakers. Thus, calculation of the TCI requires **controlling for** the effects of the discretionary factors (i.e., *holding them constant*) while simulating the effects of the cost factors. **Although the TCI should reflect differences in the costs of comparable teachers (i.e., teachers with similar characteristics assigned to similar job assignments), it should not reflect whether or not a district *chooses* to employ better educated, more experienced, or more female teachers or chooses to employ them in assignments with small class sizes.**

Highlights of the patterns of variation in teacher salaries with respect to the discretionary factors are presented below. In each case, the wage differences described should be interpreted in the context of isolating the effects of each independent or explanatory variable while controlling for variations in all other measurable characteristics of teachers, jobs, and labor market jurisdictions.

- **Sex and racial-ethnic background.** *The results show that there are sex differences favoring males and that there is some evidence of lower salaries being paid to minorities of the same sex.*

- **Teacher qualifications and effort.** *Teachers with higher degree levels and/or higher levels of state certification receive higher salaries. Three types of teacher experience contribute to additional earnings: general experience, school-specific experience, and age or maturity all have positive effects on earnings, with general experience being the most important. Undergraduate majors in mathematics, business, and physical education are associated with teacher wage differences, while generally those individuals with undergraduate majors in education do not receive higher wages. Teachers who spend nonschool time on school-related activities receive higher salaries, all else equal.*

- **Impact of the job environment.** *Teachers receive extra compensation for working with larger relative class sizes in their fields. Teachers also receive compensating differentials for working in schools with more violent student behavior or with less administrative support.*

The Cost Factors: Regional and District Characteristics That Are Outside Local Control

How do teacher salaries vary with factors outside local control? These *cost factors* encompass variations in the costs of living, competitiveness of the labor markets, the composition of students by racial-ethnic background, levels of crime, the quality of the weather, the availability of alternative job opportunities, and other attributes of the regions and districts that affect their attractiveness as places to live and work. It is anticipated that less attractive jurisdictions will have to pay relatively higher salaries to attract teachers. A district in a region with high *cost factors* but low fiscal capacity (i.e., low property wealth or low income residents) may not be able to recruit teachers with the high qualifications that they might otherwise desire. A similarly situated district with high fiscal capacity may be able to access the higher tax revenues necessary to pay teachers the higher salaries required by the market to compensate them for the high cost factors.

Highlights of the variations in teacher salaries in relation to the *cost factors* are presented below.

- **Competition in the market for teachers**. *Counties with highly competitive labor markets for teachers exhibit salaries as much as 8 percent higher. In addition, counties with tighter overall labor markets as reflected in lower unemployment rates also exhibit higher teacher salaries.*

- **Factors underlying cost-of-living differences.** *Factors associated with higher costs of living such as higher land prices and faster growth in population, are also associated with higher teacher salaries.*

- **Amenities of urban and rural life.** *In general, more densely populated areas and the larger urban areas exhibit significantly higher teacher salaries. One standard deviation above the mean in metropolitan area population is associated with a 6.5 percent salary differential. The analysis reveals higher teacher salaries in areas with higher crime rates.*

- **Climatic conditions.** *Teachers appear to give up salaries to work in regions with warmer climates (as measured by mean temperatures) and/or less annual snowfall.*

The differences in teacher salaries associated with these variables are *cost differences*. They reflect the variations in salaries paid to comparable teachers working in similar job assignments across local school systems. All else equal, larger districts in more urbanized settings tend to pay higher teacher salaries for teachers with the same qualifications. In addition, districts located in faster growing regions, regions with climates characterized by colder temperatures and greater quantities of snowfall, and regions with higher rates of crime pay higher salaries to teachers, holding all else constant. At the same time, districts in more remote regions pay somewhat higher-than-average salaries to compensate for reduced access to some of the amenities of living in more urbanized areas.

The next step in this analysis is to organize all of these factors into a comprehensive index of the variations in the cost of teacher services.

Teacher Cost Differences by Type of District

A comprehensive index of the variations in the cost of teacher services is constructed by using a regional-level TCI. The regional-level TCI includes the combined effects of all *nondiscretionary cost factors*, while controlling for certain discretionary job and teacher characteristics that affect teacher salaries. This regional-level TCI is broken down by region of the United States, population of the metropolitan area or county of location, distance from the central city, district enrollment, and type of city.[5] The mean values of the TCI represent the cost of services in the district serving the average student.

Highlights of the regional-level average TCI are:

- **Regional variation.** *The average TCI tends to be lowest in the southern part of the United States and highest in the northeastern states. Using the regional-level TCI, on average, a student in the South is enrolled in a district facing teacher costs about 8.1 percent below average, while students in the Northeast are in districts facing costs of more than 11.5 percent above average, for similar teachers in similar schools. Districts in the West exhibit teacher costs about 4.4 percent above average, while districts in the Midwest are just about at the U.S. average.*

- **Urbanicity.** *Not surprisingly, districts with higher per pupil revenues, districts located in larger metropolitan areas, districts less than 20 miles from a central city, districts with greater enrollments, and more urbanized districts all tend to have higher teacher costs. Large central city districts and those located on the urban fringe of a large city reveal the highest average costs among types of cities at about 8.2 to 9.5 percent above average. Districts within 20 miles of the central city exhibit the highest costs, while districts between 40 and 80 miles of the central city exhibit the lowest costs. Districts more than 160 miles from the central city show costs just slightly below that of the districts within the 20 mile radius. Districts in the largest metropolitan area (over one million in population) exhibit costs almost 10 percent above average, while districts in regions or counties with population less than 5,000*

[5] The regional-level TCI includes only regional- or county-level variables in the computation of the index. A district-level TCI which is calculated in the full report includes both regional- as well as district-level variables in the index. Only the regional-level TCI is presented in the executive summary since the regional factors are more easily interpreted and the standard error of the regional-level TCI is smaller than for the district-level TCI.

exhibit more than 16 percent below average teacher costs. Districts located in metropolitan areas of half a million to a million in population exhibit costs at the U.S. average.

- **Rural school districts.** *While the average student attending a rural district would have access to the average teacher at a cost about 8.5 percent below average (i.e., an index value of 91.5), the student in a remotely located district would have access to that same teacher at about the average cost (i.e., at an index value of 99.86). Although competitive forces in the labor market might tend to drive salaries down in such districts, the results suggest that compensating differentials are necessary to attract teachers into remote regions located away from the amenities of urban life.*

A Comparison of Alternative Models: The Case for the TCI

In addition to the TCI derived from the hedonic wage model, two other alternative models have been proposed for measuring teacher cost differences: these are McMahon and Chang's (1991) cost-of-living (COL) index and an updated version of Barro's (1992) average teacher salary index adjusted for variations in education and experience. While the COL of McMahon and Chang, the Barro teacher cost index, and the regional- and district-level TCIs calculated in this paper show high correlations, there are significant differences in the values of these indices and what they represent. The COL accounts only for variations in the cost of living which, while an important part of teacher cost differences, does not capture all of the relevant factors. The Barro index controls for teacher education and experience but fails to control for variations in other teacher and school attributes that are within local control.

In contrast, the TCIs presented in this paper represent an attempt to account for most of the factors that affect the ability of local school systems to recruit and employ teachers with similar characteristics hired into similar jobs and job assignments. It accounts systematically for the factors that underlie differences in the cost of living, and it accounts for differences in regional amenities that affect their attractiveness as places to live and work. It is demonstrated that despite the high correlations, there are some important differences in the ordering of regions of the country according to these alternative indices, as well as the magnitudes themselves. Using an inappropriate index for adjusting salary or expenditure, data can lead to significantly different conclusions about the levels of educational services being provided in different regions of the country.

Future Work

Future work on the analysis of teacher compensation could be improved along two dimensions. First, additional data items are needed to control for teacher quality (e.g., the quality of colleges attended, scores on Scholastic Aptitude Tests or national teacher exams). A second area in which data could be improved is with respect to benefits received by teachers. The current SASS does not report data that would permit determination of the value of benefits, which could easily add up to a total of 30 to 40 percent on top of salaries. Finally, future research in this area should expand the analysis of teacher salaries to other certified and noncertified personnel as well as personnel resources. While it is expected that patterns of school administrator costs will be similar to those for teachers, noncertified personnel tend to operate in more localized labor markets and in the past have been found to have somewhat differing patterns of cost variation than certified personnel (see Chambers 1978). Finally, in order to develop a comprehensive cost of education index, it will be necessary to obtain some data on the variations in the costs of nonpersonnel resources, which account for approximately 15 percent of school budgets.

Estimation of the teacher cost index in this paper represents a major breakthrough for researchers interested in examining the patterns of educational cost differences and in assessing the equity with which school resources are distributed across states and local jurisdictions in this country. The hope is that the desire for this information will stimulate the additional research necessary to complete the work of developing a comprehensive cost of education index.

Chapter 1

Introduction

Since the mid-1970s, a number of studies have been directed toward the development of methodologies and empirical estimation of a cost-of-education index (CEI).[1] A CEI is designed to adjust for differences in the purchasing power of the educational dollar in different jurisdictions. Such an index addresses the following question:

> *How much more or less do local education agencies located in different jurisdictions (e.g., states or other geographic locations) pay for* ***comparable*** *personnel and nonpersonnel resources?*

Because personnel expenditures account for about 80 percent of local school budgets, most of the previous studies of education cost differences have focused most of their attention on the analysis of personnel costs.[2] The studies of personnel costs differences address the following question:

> *How much more or less does it cost in different jurisdictions to recruit and employ school personnel with similar characteristics into similar jobs and job assignments?*

The purpose of the present study is to address this second question specifically for the most important school input—namely, classroom teachers.

Until recently, no national data have been available to support a comprehensive analysis of the variations in teacher salaries. With the advent of the Schools and Staffing Survey (SASS), conducted every 3 years beginning in 1987–88 by the National Center for Education Statistics (NCES), a data source has emerged that supports the empirical analysis required to develop a national, geographical teacher cost index (TCI). Because teachers represent a substantial portion of the budgets of schools, the availability of this TCI would be a major step forward in the development of an overall cost-of-education index (CEI).

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The Importance of Cost-of-Education Adjustments

The importance of developing a CEI is that it may be used in two significant ways. First, it may be used to adjust educational expenditure as teacher salary data for differences in the purchasing power of the educational dollar in different communities. As part of the movement of the late 1960s and early 1970s to improve equity in school finance, economists and other social scientists have expressed interest in analyses of the patterns of resource allocation in public schools. Ultimately, this quest to improve equity requires increasing one's understanding of how the quantities and qualities of educational inputs are distributed across school districts serving different student populations. Total current educational expenditures per pupil and average salaries of school personnel are two measures often reported across states and other jurisdictions that reflect the level of educational resources.

For the most part, published information on education expenditures and the salaries of school personnel across states and other local jurisdictions is based on actual reported values.[3] However, because of the existing variations in the costs of comparable educational resources across state and local jurisdictions, it is difficult to make comparisons of the level of educational services being provided in different locations. In order to make such comparisons of real educational services, it is necessary to adjust educational expenditure data for differences in the purchasing power of the educational dollar across jurisdictions.

Similarly, the reported levels of teacher salaries across states or local jurisdictions hide the extent to which the observed differences may be attributed to differences in teacher qualifications or in local costs of living. Thus, the nominal salary data that are commonly reported reveal little about relative differences in the level of teacher services across states or localities. What is required is a way of adjusting the observed salary data in order to obtain an estimate of real differences in teacher services: that is, a measure of teachers' compensation that the controls for variations in the costs of living and other factors that affect the willingness of teachers to live and work in particular local jurisdictions.

Second, in addition to their importance for reporting expenditure and salary data, such cost adjustments in education play a significant role in analyses of the demand for educational services and resources across communities.[4] Communities facing higher relative costs of educational resources will be expected to reduce the quantity of demand for these resources. If the demand for educational services is relatively inelastic (i.e., relatively unresponsive to real cost differences), then total expenditures on educational services will increase. If demand for services is relatively elastic (i.e., relatively responsive to real cost differences), then total expenditures on educational services will decline.

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[3] For example, see the publications of the National Center for Education Statistics (NCES) on the *Public Elementary and Secondary State Aggregate Data, for School Year 1990-91 and Fiscal Year 1990* (NCES Report No. 92-033).

[4] Examples of studies of the demand for educational expenditures and demand for educational resources (e.g., staff/pupil ratios) at the local level include Barro (1974), Chambers (1975 and 1979), Feldstein (1975), and Ladd (1975).

Studies of educational resource allocation have commonly had to resort to using such measures as average teacher salaries or other proxy variables (e.g., opportunity wages in other occupations) to reflect relative costs of school resources. Unfortunately, variations in average teacher salaries reflect both variations in costs as well as the qualifications of the teaching staff. In this kind of analysis, what is required is an index of the relative cost of comparable teachers. Differences in teacher qualifications are part of the level of educational resources over which local school officials are making allocation decisions in the first place.

The importance of accurately controlling for costs in these analyses is that ultimately such studies are often focused on addressing the impact of changes in state or federal policies or funding formulas. Without the ability to control for the impact of resource costs on choices of local school district officials, it is not possible to isolate the effects of state and federal policies on patterns of resource allocation in local schools.

Toward the Development of a TCI

As the next step beyond using average teacher salaries, Barro (1992) developed a model that adjusts the variations in average teacher salaries for variations in the levels of education and experience. Barro's cost index implicitly attributes all remaining variation in teacher salaries after controlling for education and experience to differences in costs. While this model represents a significant improvement over using an adjustment based on average teacher salaries, it still does not account systematically for other teacher characteristics (e.g., personal attributes such as racial-ethnic background or sex) or attributes of the work environment (e.g., class sizes or types of students taught) that may affect the average level of teacher compensation and that must be controlled in assessing variations in teacher costs.

Other researchers (e.g., see McMahon and Chang 1991) have suggested utilizing a *cost-of-living* adjustment to account for the variations in the purchasing power of the education dollar. Unfortunately, the cost of living is only one component of the variations in the costs of school personnel. Above and beyond the variations in the costs of living, public schools serving more challenging student populations or located in high crime areas may have to pay higher salaries to teachers to compensate them for the more difficult working conditions. Similarly, public schools located in moderate climate zones or in areas with greater access to shopping, medical services, or cultural activities may tend to pay relatively lower salaries for comparable teachers. In other words, one would expect that public schools located in regions offering a more pleasant environment in which teachers may work and live will pay relatively lower real salaries for comparable teachers.

To capture such variations in teacher costs requires a comprehensive analysis of the patterns of teacher compensation. It requires a model that portrays the complexities of the employment transaction between an individual teacher and the school district; that is, one that accounts for school district preferences for teacher qualifications and individual teacher preferences for working and living conditions in local communities. The *hedonic wage model* provides such a comprehensive conceptual framework for understanding and sorting out the various factors that underlie variations in the patterns of teacher compensation. This model is well suited as a tool to isolate the impact of regional amenities and costs of living on teacher salaries while controlling for various teacher and job characteristics. The Schools and Staffing Survey (SASS) administered by NCES offers a unique opportunity to examine these patterns of variation in teacher compensation using hedonic wage analysis.

Objectives of the Present Analysis

The TCI analysis presented here accomplishes three objectives. First, the TCI component extends the analysis of teacher compensation to include specific variables that will support the estimation of variations in the patterns of teacher "costs." The term "cost" as used here means the cost of comparable units of teaching services, and "comparable" refers to the characteristics of teachers and their working conditions that are within the control of local school district decisionmakers. The data derived from the SASS questionnaires are matched to Census and other data sources that provide information on the characteristics (e.g., amenities) of the jurisdictions and regions within which public schools are located. Merging these Census and other data sources with SASS improves the quality of the overall analysis of variations in teacher compensation by going beyond the series of dichotomous variables that describe the types of regions (e.g., large city, small town, rural community) in which the schools were located. Rather, these data contain specific information about the characteristics of the region: for example, land prices, climatic conditions, crime rates, unemployment conditions, competitiveness of the teacher labor market, population of the region, population of the closest central cities, and distances to the closest central cities.

Second, the empirical analysis of teacher compensation is used to estimate an average TCI for each state. This index will be a single number for each state representing an estimate of the level of teacher salaries in that state associated with that state's levels on factors that are outside the control of public school decisionmakers. This index will also answer the question for each state about *how much more or less it would cost relative to other states to recruit and employ teachers with similar characteristics.* A single index number for each state could be used to adjust state-level statistics on public school teacher salaries or educational expenditures for differences in costs.

Finally, the dataset developed for this analysis is used to estimate a regional- as well as district-level TCI for every school district in the country. The regional-level TCI includes regional-level influences on teacher costs. The district-level TCI encompasses both the regional- and the individual district-level influences on teacher costs. As one would expect, the district-level TCI shows a wider variation in costs than the regional-level TCI. Nevertheless, the regional-level TCIs provide an important and significant advance in the theoretical and empirical methodology for estimating such cost indices.

This report also provides comparisons of the TCIs derived from the hedonic wage model with the variations across states in the cost-of-living index developed by McMahon and Chang (1991), average teacher salaries, and an updated version of Barro's (1992) average teacher salary index adjusted for variations in education and experience. This report concludes with recommendations regarding what further data might be needed to improve upon the TCI estimation process and what needs to be done to expand the application of this methodology to other school personnel (e.g., administrative, professional support, paraprofessional, clerical, and maintenance or custodial personnel).

Conceptual Framework: The Hedonic Wage Model

In an earlier paper, Chambers (1981a) described the hedonic wage model as follows:

> *The intuitive notion underlying this theoretical structure is that individuals care both about the quality of their work environment as well as the monetary rewards associated with particular employment alternatives, and that they will seek to attain the greatest possible personal satisfaction by selecting a job with the appropriate combination of monetary and non-monetary rewards. Similarly, employers are not indifferent as to the characteristics of the individual to whom they offer particular jobs. The result of these simultaneous choices is the matching of individual employees with employers. It is the result of this matching process itself that reveals implicitly the differential rates of pay associated with the attributes of individual employees and the working conditions offered by employers. More formally, it is the supply of, and demand for, individuals with certain personal attributes to any particular kind of job assignment that determines the equilibrium wages of labor as well as the implicit market prices attached to the personal and job characteristics.*
>
> *The implicit relationship observed between wages and the personal and job characteristics of individuals is referred to as a hedonic wage index. The word hedonic literally refers to the physical and psychic pleasures that one can derive from engaging in certain activities. In the context of labor markets, the word hedonic refers to the satisfactions or utility derived by employees from the characteristics of the work place and the profits or the perceived productive value derived by employers from the characteristics of employees they assign to certain jobs. The hedonic wage index permits one to decompose the observed variation in the wages paid to labor into the dollar values attached to each unit of the personal and workplace characteristics (p. 51).*

The hedonic wage model can be used to estimate variations in the compensation of teachers in relation to personal, job, and locational characteristics.[5] Ordinary least squares regression is utilized to estimate the parameters of the model. The estimated coefficients provide a foundation for determining the wage premiums (positive or negative) associated with particular personal, job, or locational characteristics.

This analysis will reveal wage premiums for attributes of the workplace and the employee that are not commonly included in regular salary schedules. For this reason, the coefficients are said to provide estimates of the *implicit* prices of particular attributes. The patterns of implicit prices for worker attributes are created by packaging them as bundles and matching them to the bundles of job characteristics. The location of teachers in schools represents a process of choice for the teachers (on the supply side) and for the school decisionmakers (on the demand side) that reveals the trade-offs among the teacher attributes and job characteristics; these trade-offs provide the basis for the set of implicit prices.

Mathematical Formulation of the Model

The reduced form of the hedonic wage model used for the analysis of teacher costs may be expressed as follows:

$$\ln(SALARY_{ij}) = \hat{\alpha} + \hat{\beta}_T \bullet T_i + \hat{\beta}_C \bullet C_i + \hat{\beta}_S \bullet S_i + \hat{\beta}_D \bullet D_j + \hat{\beta}_R \bullet R_j + u_{ij}$$

(Eq. 1.1)

where i refers to the ith teacher, j refers to the jth district. The Greek symbols appearing in equation 1.1 above are the coefficients (*or parameters*) to be estimated using multivariate regression techniques. The error term in the regression is represented by u_{ij} and is assumed to be normally distributed with mean zero (=0). The terms T_i, C_i, S_i, D_j, and R_j are described below.

The dependent variable in this analysis is the natural log of SALARY, which is defined as the annual earnings of the teacher from the school district, including the base academic salary and any additional pay received for special job assignments. The log form of the dependent variable is commonly used for earnings equations such as this one because the hedonic wage function is theoretically specified as a nonlinear equation (Rosen 1974). In addition, the log

[5] For other attempts at using the hedonic wage model for analyzing teacher salaries, see Antos and Rosen 1975; Ballou and Podgursky 1993; Chambers 1980b, 1981b; and Wendling 1979).

form also permits easy determination of the percentage effects of the independent variables on the dependent variable—in this case, on teacher salary levels.[6]

The set of independent variables used in the analysis of variations in teacher salaries may be divided into two subsets: the *discretionary factors* and the *cost factors*. The discretionary factors are those within the control of local school district decisionmakers in the long run. These include the characteristics of teachers and the attributes of the jobs to which they are assigned. In the long run and within the limits of the supply of teachers who are offering services, school decisionmakers have some control over the set of teacher attributes they employ. The only constraint that they face is that they must purchase a bundle of characteristics that are tied together in each particular individual they employ. In addition, school decisionmakers have control over the job titles and the specific attributes of the jobs to which they assign teachers. For example, these job attributes include such characteristics as the types of students served and the class sizes. In order to calculate the TCI, one needs to control for, or eliminate the impact of, the variations in these discretionary factors.

The second set of independent variables are referred to as the cost factors. These are the factors that are used directly in the calculation of the TCI—the relative cost of recruiting and employing similar teachers in similar jobs across local jurisdictions. They are referred to as cost factors because they are outside the control of local decisionmakers. These variables include the attributes of the jurisdictions and regions in which districts are located and in which teachers must live and work. And they are those variables which ultimately affect the willingness of teachers to live and work in these localities. Included among these factors are measures of labor market competition, factors reflecting costs of living, and factors that reflect the attractiveness of these jurisdictions and regions as places to live and work (e.g., crime rates, congestion, climatic conditions, and access to urban amenities).

The independent variables included in equation 1 are listed in table 1.1.

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[6] If additional information could be obtained that would permit placing a value on fringe benefit contributions by the district, equations could be estimated using teacher compensation including salary and benefits. Unfortunately, the SASS database does not currently provide any information regarding how much public or private schools expend for various fringe benefit packages received by teachers. The SASS database does report information on the types of benefits available to teachers and received by them. The dollar value of these benefits, however, is not reported. Data from one author (Chambers 1985), however, suggest that variations in teacher compensation (salaries and benefits combined) across local school districts exhibit the same basic patterns as variations in teacher salaries. Nevertheless, no data in the present survey and analysis would permit one to confirm or refute this hypothesis.

It has been suggested by some reviewers that the dependent variable for this analysis should have been academic salary only and that additional pay received for special job assignments should be analyzed separately. This would only be true/valid if the additional pay and academic salary were truly separable in the employment transaction. This issue is discussed further in the technical Appendix A under *Choice of Dependent Variable*.

Table 1.1— List of independent variables

DISCRETIONARY FACTORS:

Individual teacher characteristics (T):
sex;
racial-ethnic background;
marital status;
membership in professional teacher or educational organization;
age,
total years of teaching experience (general experience),
total years in the present school (school-specific experience), and
number of breaks in service;
highest degree level;
undergraduate major.

Job assignment or classroom (C):
percentage of full-time;
nature of assignment (itinerate or substitute teacher);
index of relative class size for teachers in similar subjects;
whether the teacher is a mentor;
percentage of time teaching out-of-field;
nonschool time spent on school-related activities;
whether the teacher assigned homework in the most recent week;
percentage of time teaching high- or low-achieving students.

School (S) characteristics:
indices of student behavior and problems;
indices of teachers' sense of support, control, influence, and overall satisfaction with their work environment;
racial-ethnic composition of the students at the school;
percentage students absent on a recent day;
school type (i.e., elementary, secondary, special education, vocational, alternative).

COST FACTORS:

District level (D):
racial-ethnic composition of the students in the district;
district size as measured by enrollment;
percentage growth in enrollment.

Regional level (R):
percentage of total county enrollment accounted for by the largest district in the county;
measures of the distances from the closest central city;
percentage change in county population over the past decade;
value per acre of farm land;
population and density of the county and metropolitan area;
county unemployment rate;
measures of climatic conditions (mean temperatures and snowfall);
county-level crime rates;
number of banks per 100,000 population.

The independent variables listed in table 1.1 are expressed in a variety of mathematical forms:

- Dichotomous dummy variables (i.e., variables that designate whether or not a particular characteristic is present). For example, is the teacher a mentor teacher or not? Is the teacher a secondary teacher or not?

- Percentages: for example, the percentage growth in enrollment or percentage of students who are classified in a particular racial-ethnic group.

- Natural logs (*ln population density)*. This is the same form as the dependent variable (i.e., the natural log of teacher salary).

- Direct measures (i.e., with no transformation): for example, age or total years of teaching experience are entered directly into the equation.

- Quadratic terms (i.e., square of another variable): for example, in addition to teacher experience, the variable teacher-experience-squared is also included in the equation. The addition of the squared term permits estimation of curvilinear relationships.

In the analyses presented in this report, the teacher salary differentials associated with variations in the independent variables are most often presented as percentage effects in the tables. A detailed listing of the mathematical forms used for each independent variable in the regression is presented in Appendix B in the tables of descriptive statistics and parameter estimates for the regression equations used in this analysis.

The Role of Socioeconomic Status Variables

It is notable that certain socioeconomic status (SES) variables have been consciously excluded from the set of independent variables used in this analysis. In fact, data were available from the NCES Census Mapping Project on such items as median family income, median housing value, and measures of student poverty or at-risk populations. What role does SES play in the determination of teacher salaries? Are these SES measures a reflection of local school district fiscal capacity? Does SES affect the preferences for educational services or for specific types of educational inputs (e.g., “better” teachers)? Or is SES a working condition for teachers? Do some of these SES measures reflect differences in the cost-of-living in a region?

If SES measures fiscal capacity or preferences for educational services or inputs, then it has an indirect effect on teacher salaries. For example, districts with greater fiscal capacity will exhibit a willingness to spend more on educational services. Increased spending will in turn permit local districts to exhibit demand for teachers with more of certain attributes or qualifications. The greater level of demand for certain teacher attributes or qualifications will be associated with higher salaries, all else equal. Thus, in this instance, the effect of SES on teacher salaries operates through the effects on local educational spending which in turn affects demand for teacher attributes and hence salary levels. Inclusion of SES variables in the model in this case would involve a specification of the formal model of teacher wage determination.[7]

Is SES a measure of working conditions for teachers? Do teachers have a preference for teaching higher SES students? Are such students easier to teach and therefore preferred by teachers? If this were true, then one would expect teachers to give up wages to teach in districts with higher SES students. This author would argue that rather than being a direct measure of such working conditions, SES is a proxy measure. On the surface, one might hypothesize that SES is included in the analysis of teacher salaries to reflect the conventionally accepted notion that lower SES students may tend to be lower achievers, are perhaps more involved with violence, or are more likely to have family problems. This author would argue, however, that if it is these correlates with SES that are the underlying reasons for their inclusion, then it would be preferable to include more direct measures of these school or student characteristics. That is, rather than SES per se being the reflection of the working condition, it seems more reasonable to hypothesize that the behaviors of the students or the evidence of problems in the interactions with their families are more likely the factors that underlie teachers' attitudes toward a school environment. Instead of SES measures, the present analysis includes information about whether or not the teacher is assigned to high or low achieving students, as well as three scales that reflect the level of students' self-abusive behavior, the level of violent student behavior, and the level of family problems.[8]

A third rationale for including SES measures as independent variables is that such variables as median family income or housing value reflect cost-of-living differences in local communities. While each of these measures has a relationship with the cost of living, they also reflect many other factors besides the cost of living, which would confound the estimation of a teacher cost index. Localities with higher costs of living will certainly exhibit higher median family incomes, and higher housing values contribute also correlate with higher costs of living.

But what are the factors that underlie higher costs of living? Is it greater housing values or median family income per se, or are there other more direct measures of the underlying factors that create cost-of-living differences across regions? The goal is to utilize measures that as much as possible represent the underlying cause of cost-of-living differences rather than proxy measures or variables that are simply correlates. It is not higher housing values per se, but the higher costs of land that underlie the greater housing costs. Land is the immobile factor of production, and its productivity or the amenities that characterize a region ultimately are reflected in the prices of land. These differences in land prices are one of the factors that cause cost-of-living differences. However, median housing values reflect not only the value of the

[7] For a more formal specification of the hedonic wage model, which illustrates the effects of district fiscal capacity on teacher wages, the reader is referred to Chambers (1981b).

[8] Each of these scales is based on a series of survey items asked of teachers. A discussion of how these scales were created and the elements included in each is presented in Appendix A, the *Technical Notes*.

land, but also the collection of features of the housing stock such as the average lot size, the average square footage of the interior space, and the quality of the construction.

As with median housing values, the variations across local jurisdictions in median family income reflect not only variations in the cost of living, but also variations in the characteristics of the work force. Areas with a greater percentage of highly educated professional workers will also exhibit higher median family incomes. Thus, the composition of industry and the work force in a locality will affect median family income. Thus, median family income is simply a correlate of the cost of living and not an underlying cause of the observed differences per se.

For all of these reasons, four collections of variables were selected to reflect cost-of-living differences: the price per acre of agricultural land, the distance from the central city, whether the district is located within 75 miles of two or more central cities, and the growth in local population over the past decade. The minimum price per acre of agricultural land in all of the counties in a metropolitan area (or simply the average price per acre of agricultural land in a nonmetropolitan county) represents the cheapest use of land in an area. Thus, the price per acre of agricultural land represents a base price of land within an area. The distance from the central city is utilized to reflect the notion that land in different parts of an urban area will be valued differently simply by virtue of access to centers of employment and access to the cultural and commercial amenities of urban life (i.e., land in the central city is generally more valuable and hence more costly). Regions with higher base prices of land will have higher costs of living, and districts within a metropolitan area that are further from the central city are expected to have somewhat lower costs of living. Moreover, districts which are located between or adjacent to (i.e., less than 75 miles from) more than one central city and hence center of employment may have higher land values and hence higher costs of living. Finally, regions exhibiting faster growth in population will also exhibit higher costs of living due to increasing demand for local goods and services.

Thus, the SES measures reflect differences in fiscal capacity, are proxies for working conditions, and are only correlates of cost-of-living differences. They do not represent direct measures of the underlying factors that cause teacher cost differences. With all of these concerns in mind, the inclusion of SES measures would actually create a serious confounding of *cost* and *discretionary* factors in the determination of teacher salaries. For this reason, it would be preferable from a measurement point of view to include, as has been done as much as possible in the present study, the characteristics of regions or districts that represent the root causes of differences in teacher salaries.[9]

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[9] A more detailed explanation of the theoretical model underlying the present analysis and the rationale for why these types of census data are not included directly in the teacher salary equation is presented in Chambers 1981a and 1981b.

The Data and Sample Design

The data for this study were derived primarily from the Schools and Staffing Survey (SASS) administered by the National Center for Education Statistics (NCES). Large random samples of teachers, schools, and districts are included in this data collection effort. Data for this study were taken from the teacher-, school-, and district-level questionnaires. The files from which the analysis dataset was derived contained responses from 46,750 public school teachers across 8,969 public schools and 4,884 public school districts. In the statistical analyses, the data are weighted in order to produce nationally representative numbers of teachers, adjusting for the complex stratified sample selection process and the response rates for each questionnaire. Some small numbers of missing values for school enrollment and racial-ethnic composition are filled in using the nonfiscal surveys of the Common Core of Data, also conducted by NCES.

Data for the regional and jurisdictional characteristics of districts and the counties in which they were located were gathered from the Census Bureau, the U.S. Geological Survey, and the National Climatic Data Center.

The Sample Size

The actual sample of public school teachers included in the final regression equations was 40,484. There were a number of reasons why the full SASS sample of 46,750 public school teachers was not used. First, the sample of public school teachers for this analysis was restricted to classroom teachers in order to increase the compatibility of the measures of classroom working conditions across individual teachers (e.g., the meaning of class sizes and the types of students served). These elementary enrichment teachers commonly serve an entire school rather than a single classroom. Class sizes or caseloads mean different things to enrichment teachers, and characteristics of the types of students served (e.g., high versus low achieving students) would not be based on a class, but rather a school variable. More than 1,300 elementary enrichment teachers were excluded from the analysis because of this compatibility issue.

In addition, the sample was reduced in size by almost 3,000 teachers because there was no SASS district survey that matched to the individual teacher survey. An additional 2,000 teacher observations were lost because there was no matching school observation. We also lost small numbers of teachers (approximately 300) because of missing census mapping information that was used to match climatic and central city data.

Technical details on these various files are presented in Appendix A of this report.

The Sample Design

The statistical analysis of teacher salary differences does take into account the complex sampling design of the SASS dataset. The regression estimates were obtained using ordinary least squares with each observation weighted according to the appropriate sampling weight provided in the SASS dataset. The complex sample design of the SASS dataset was accounted for in the methodology used to estimate the standard errors of the regression coefficients. These standard errors were estimated using the method of balanced repeated replication (BRR) using the 48 sets of replicate weights for teachers. Each coefficient was estimated 48 times and the standard deviation of the coefficient among these estimates serves as an estimate of the standard error of the coefficient.

Organization of this Report

Chapter 2 of this report focuses on the impact of the *discretionary factors* on teacher salaries. These are the factors such as teacher characteristics, job assignment characteristics, and school characteristics over which local school district decisionmakers exert some control. These are the factors that need to be controlled in order to isolate real teacher cost differences. Chapter 3 will focus on a discussion of the remaining sets of independent variables included in the analysis: that is, the *cost factors*. These are the factors such as the differences in the competitiveness of the labor market, the factors underlying the cost-of-living differences, and the factors that affect the attractiveness of various regions as places to live and work—all of which affect the supply of, and hence, the price of the services of, comparable teachers.

Finally, chapter 4 uses the analysis from chapter 3 to calculate alternative teacher cost indices (TCI). A regional- as well as district-level TCI is calculated. Teacher costs are examined across states as well as across districts serving different populations of children and families. This final chapter also presents alternative models that have been proposed for calculating teacher cost adjustments. The alternative models are compared to the TCI calculated in this report, and the advantages and disadvantages are discussed. It will be argued in this last chapter that the TCI calculated in this report includes important additional factors beyond the costs of living that need to be taken into account in examining how much more or less it costs to recruit and employ comparable teachers.

Chapter 2

The Discretionary Factors: The Effects of Teacher and Job Characteristics on Patterns of Variation in Teacher Salaries

The patterns of teacher compensation across local school systems are ultimately a reflection of a multitude of supply and demand decisions made by potential teachers and their employers—namely public school systems. The level of compensation is the metric by which economic value is conveyed, and it provides the information needed to measure and compare the trade-offs between and among different teacher and job characteristics. The purpose of this chapter is to examine the elements over which school decisionmakers have some discretion or control—that is, the relationships between compensation and certain teacher and job assignment characteristics.

The TCI is designed to reflect variations in teacher salaries associated with factors that are outside the control of local school decisionmakers. Thus, calculation of the TCI requires controlling for the effects of the discretionary factors (i.e., holding them constant) while simulating the effects of the cost factors. **Although the TCI should reflect differences in the costs of comparable teachers (i.e., teachers with similar characteristics assigned to similar job assignments), it should not reflect whether or not a district *chooses* to employ better educated, more experienced, or more female teachers or chooses to employ them in assignments with small class sizes.**

Highlights of the findings contained in this chapter are presented below. In each case, the wage differences presented in this report should be interpreted in the context of isolating the effects of each independent or explanatory variable while controlling for variations in all other measurable characteristics of teachers, jobs, and labor market jurisdictions.

- **Sex and racial-ethnic background.** *The results show that there are sex differences favoring males and that there is some evidence of lower salaries being paid to minorities of the same sex.*

- **Teacher qualifications and effort.** *Teachers with higher degree levels and/or higher levels of state certification receive higher salaries. Three types of teacher experience contribute to additional earnings: general experience, school-specific experience, and age or maturity all have positive effects on earnings, with general experience being the most important. Undergraduate majors in mathematics, business, and physical education are associated with teacher wage differences, while generally those individuals with undergraduate majors in education do not receive higher wages. Teachers who spend nonschool time on school-related activities receive higher salaries, all else equal.*

● **Impact of the job environment.** *Teachers do receive extra compensation for working with larger relative class sizes in their fields. Teachers also receive compensating differentials for working in schools with more violent student behavior or with less administrative support.*

The hedonic wage equation utilized for this analysis is presented in table B.2 in Appendix B of this report. The means and standard errors of the dependent and independent variables included in the equation are presented in table B.1 of Appendix B. In the discussion presented below, the impact of the subsets of teacher and job attributes are translated into the percentage effects on teacher salaries.

Differences in Teacher Sex and Racial-Ethnic Background

What does the prior literature on labor economics indicate about differences in the earnings between male and female teachers and between teachers of different racial or ethnic backgrounds? Certainly no formal salary scales in the public and private school sectors would take sex or racial-ethnic background into account in setting salaries. Nevertheless, previous literature on teacher salary differentials has shown patterns of variation with respect to sex and race.[10] The present analysis attempts to shed further light on such salary differentials.

Table 2.1 presents differential salaries associated with sex and racial-ethnic background of individual public school teachers. Perhaps the most notable result is that both white males and Hispanic males in the public sector earn higher salaries than white females, all else equal. In both cases, this differential exceeds 5 percent.

If sex is not explicitly recognized in formal salary scales, then why are such sex-based salary differentials observed? The reason is that the analysis method used (multivariate regression) controls for many more teacher and school characteristics than those reflected explicitly in teacher salary scales. When other characteristics such as education, age, and working conditions are held constant, female teachers earn less than males. One way of interpreting these results is to suggest that for a given salary, schools are able to attract more highly qualified females than males. Or, in other words, the cost of employing a highly qualified male teacher is higher than the cost of a similarly qualified female. This may simply reflect the salary differences that exist in the larger labor market within which males and females compete.

[10] For studies of teacher salary differences in which sex and racial-ethnic differences are taken into account, see Augenblick and Adams, 1979; Ballou and Podgursky, 1993; Chambers, 1978a, 1978c, and 1985; Antos and Rosen, 1975; and Wendling, 1979.

Table 2.1— Percentage difference between salaries paid to male and female teachers of various racial-ethnic backgrounds compared to white females, by sector: United States, 1990–1991

Racial-Ethnic Background	Percentage Effect
White female teachers (the comparison group)	
Asian/Pacific Islander male teacher	2.59
Black male teacher	0.90
Hispanic male teacher	5.91**
American Indian/Alaskan Native male teacher	-0.51
White male teacher	5.33**
Asian/Pacific Islander female teacher	2.18
Black female teacher	-1.93
Hispanic female teacher	0.20
American Indian/Alaskan Native female teacher	-3.99

Level of significance: *=.05, **=.01. The significance levels test whether the coefficients for each race-ethnic group are different from white females which is the comparison group. For example, this table indicates that white male teachers earn 5.33 percent more than white females.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table 2.1 indicates that white males in the public sector earn statistically significantly more (about 4.43 percent [= 5.33 - 0.90]) than black males.[11] Similarly, Hispanic male teachers in the public sector earn statistically significantly more (about 5.01 percent [=5.91 - 0.9]) than black males. There is no statistically significant difference between the salaries of black males and white females in the public sector.

Differences in salary between male and female teachers may be associated with marital status—which may contribute to limited labor market mobility, particularly among females. Previous studies (Chambers 1985) of teacher salaries have reported a negative relationship between salaries and whether an individual's mobility in the labor market is limited by a spouse's employment. Although the SASS questionnaire does not address the issue of mobility, it did include marital status. As shown in table 2.2, the analysis reveals a negative and statistically significant relationship between teacher salaries and marital status. Chambers (forthcoming) estimates separate equations for males and females and shows that marital status has a negative and statistically significant effect on salaries only for female teachers in public schools. These results are consistent with the traditional expectation that males are more influential than females in the employment and relocation decisions of married couples. The notion is that females will find a job in whatever region their husbands find their best jobs. The result is that females may be somewhat more limited in their labor market mobility, forcing them to accept somewhat lower wages than they otherwise would.

[11] When separate equations are estimated for males and females by level (elementary versus secondary) in each sector, no statistically significant differences in salaries associated with racial-ethnic background are observed (see Chambers, forthcoming). Estimation of the separate equations for males and females by level and sector has the effect of reducing the sample sizes of racial-ethnic minorities which results in larger standard errors and increased difficulty in identifying significant results.

Table 2.2— The relationship between teacher salaries and marital status: 1990–91

	Percentage Effect
All public school teachers combined	-1.23%**

Level of significance: *=.05, **=.01. The significance levels test whether these estimates are different from zero. The equations and analysis underlying the discussion of the separate equations for males and females is taken from Chambers (forthcoming).
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Differences in Teacher Level and School Type

Do secondary teachers earn more than elementary teachers? Does the type of school (e.g., special education, alternative, or vocational school) affect implicitly the level of pay received by teachers? Do teachers prepared to teach to the different populations of students in specialized schools receive different levels of compensation than other teachers who are otherwise similarly situated? Teaching level and type of school are examined below as potential sources of salary differences among teachers.

In public schools, secondary teachers earn about 2.5 percent more than their elementary counterparts, all else equal.[12]

In addition to regular elementary and secondary schools, the SASS database includes samples of teachers employed in special education, vocational/technical, and alternative schools. Each of these schools serves a unique population of students and may be characterized by different educational technologies than regular elementary and secondary schools. Special education schools generally serve the more severely disabled populations of students in small class size environments. Vocational/technical schools are more oriented toward career education or technical subject matter. Alternative schools are generally characterized as serving hard-to-reach student populations who for one reason or another are not succeeding in the traditional school environment. Staff/student ratios may tend to be lower, and alternative approaches to teaching may be utilized to meet the needs of these special populations.

Table 2.3 shows salary differences for teachers employed in these three types of schools. Once controlling for all of the other characteristics of the teachers and schools, public school teacher salaries do not vary significantly according to whether they are employed in special education, vocational/technical, or alternative schools.

[12] A variable indicating the grade level at which the teacher was teaching was used rather than the level of the school.

Table 2.3— Percentage effect of school level or type on teacher salaries

	Public Sector School Teachers
School level:	
Teacher is secondary level	2.46%**
School type:	
School is special education	2.65
School is vocational/technical	1.11
School is alternative	4.21

Level of significance: *=.05, **=.01. The significance levels test whether these estimates are different from zero.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Differences in Teacher Qualifications and Effort

Teachers bring a variety of levels of experience and educational preparation to the classroom. In addition, each exerts a different level of effort in the way duties are carried out. The following discussion focuses on the relationship between teacher salaries and some of the dimensions of experience, education, and effort.

Years of Experience and Breaks in Service

Three separate measures of experience were utilized in the analysis of salaries: years since first began teaching, total years in the present school, and age of the teacher. In addition, the number of breaks in teaching service are also included in the regression analysis. While one would expect a high correlation among these variables, there was enough independent variation that separate effects were detectable in the statistical analysis. The reason for using all three of these variables is that each represents a different aspect of experience. It is hypothesized that total years since first began teaching is the most important because it reflects the overall maturity in the teaching profession. It represents the acquisition and accumulation of *general knowledge* of the teaching professional that can be applied in any teaching position.

Total years of experience *in the present school* reflect the acquisition of *specific knowledge* of the school and school system within which the individual is employed. While there are similarities among school systems, much of this specific knowledge is not transferrable across systems. Finally, the *age* of the individual reflects the *maturity* and accumulation of general life experiences that might tend to make one more valuable as a teacher.

It was hypothesized in the formulation of the regression model that the incremental value of each type of experience would tend to decrease over time and would finally reach a peak, after which it would decline. Even looking over the life cycle of teachers, one finds that annual longevity salary increments stop after about 12 to 15 years and that further longevity increments being awarded after a total of 20 or 25 years of teaching. Thus, although teacher salary scales may increase over time, the real wage (actual wage corrected for cost-of-living differences over time) for any given teacher may not continue to rise to retirement because of the truncation of these longevity increments. For these reasons, a curvilinear relationship was specified between salaries and years of experience.[13]

Figure 2.1 displays these relationships through simulated age-earnings profiles reflected in the public sector (i.e., table B.2). This profile is constructed using the parameter estimates for the linear and quadratic terms for the teachers' total experience (i.e., years since began teaching), years in the school, and age. The effects of all other factors on wages are controlled for (i.e., removed from) the age-earnings profiles in figure 2.1. Only the effects of the various measures of experience are reflected in figure 2.1. The starting salary is based on the average salary of new teachers at age 24 from the SASS sample. For the sake of simplicity, a perfectly colinear path for the age and experience variables is assumed and runs through a 42-year career to age 66. The vertical axis shows the earnings level for each category of teacher. The horizontal axis traces the age and experience level of the individual teacher. The lower portion of the figure represents the relationship between earnings and total years of teaching experience. The difference between the second and first lines delineates the incremental impact of the years in the school. Finally, the difference between the top line and the second line represents the incremental association between age and earnings. The top line reflects the overall age-earnings path.

These age-earnings profiles are consistent with the hypotheses and with age-earnings profiles that have been reported in the literature for other professions (e.g., see Hanoch 1967). These estimates show a steady though declining rate of increase in salary until about age 58 after which the real wage declines.

The patterns of differences associated with general and school-specific teaching experience and with teacher age are shown in table 2.4. They show that overall teaching experience contributes the largest proportion (more than 2 percent in early years) to the annual salary increment. Years in the school add less than 1 percent per year, and age adds only about one-fourth of 1 percent per year. After 12 years of experience, the cumulative salary differential associated with general teaching experience is 23.53 percent. This cumulative salary differential for school-specific experience is 8.56 percent and for age it is 1.72 percent. That is, general teaching experience is valued more highly than specific experience in the school, and, in turn, specific teaching experience in the school is more highly valued than general maturity (i.e., as reflected by age).

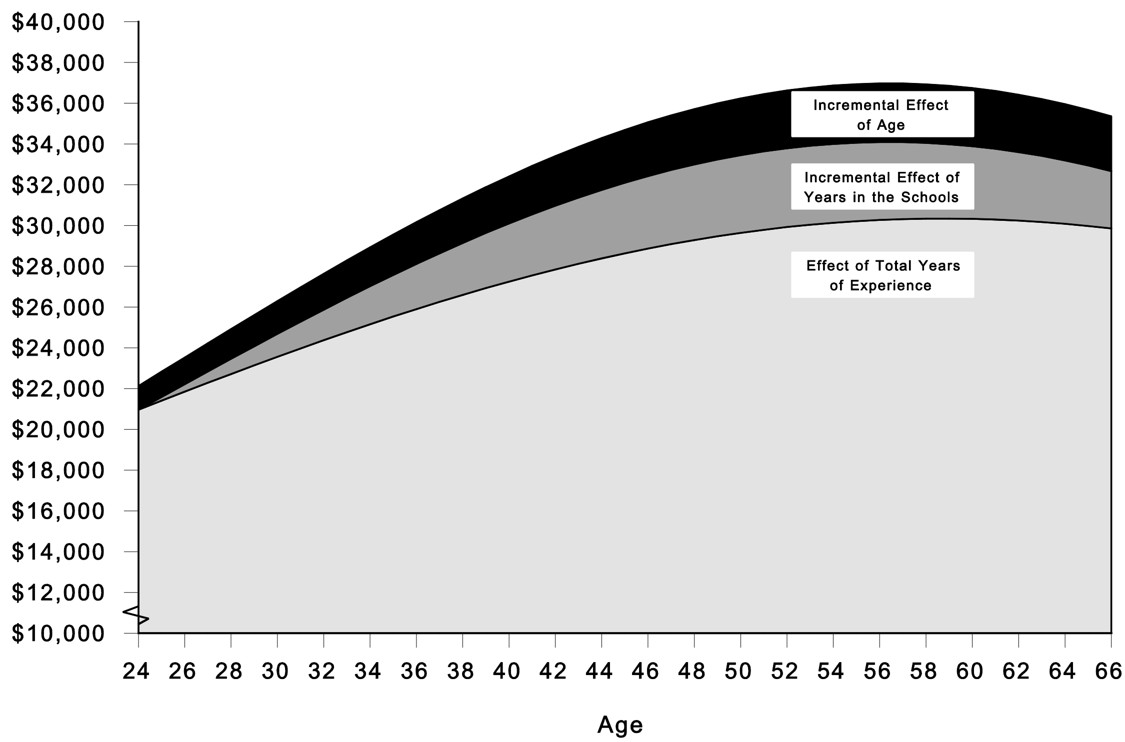
[13] This is accomplished by including a linear and quadratic (or squared) term in the regression equation.

Table 2.4— Additional earnings of public school teachers associated with experience and age: 1990–91

Type of Experience	Cumulative Percentage Salary Differential After: 1st Year	12th Year
Years since first teaching position (general teaching experience)	2.12%**	23.53%**
Years teaching in present school (school-specific experience)	0.86**	8.56**
Age (as a reflection of teacher maturity)	0.17*	1.72*

Level of significance: *=.05, **=.01. The significance levels test whether these estimates are different from zero.
Source: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Figure 2-1.-- Age earnings profiles for public school teachers



Note: Based on the parameter estimates in the public school equation in table B.2 in Appendix B, the increment added on for total years since began teaching (TYR TCH) is as follows: Salary Increment for TYR TCH = 0.0213 x TYR TCH - 0.0003 x TYR TCH2
The increment for years in the present school (TYR SCH) is as follows: Salary Increment for TYR SCH = 0.0087 x TYR SCH - 0.0002 x TYR SCH2
The increment for age (AGE) is as follows: Salary Increment for AGE = 0.0029 x (AGE-24) - 0.0000 x (AGE-24)2

SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Another aspect of teaching careers that affects the age-earnings profile is the number of breaks in service of one year or more. The SASS survey asked teachers how many times they stopped teaching to pursue other activities (e.g., raising children, returning to school). Such breaks in service may interrupt the accumulation of human capital (i.e., the general knowledge and skills required for teaching) and are expected to be negatively associated with salary levels. In fact, each break in service was associated with a statistically significant 2.87 percent loss of salary (table 2.5).[14]

Table 2.5— Public school teacher salary differential associated with breaks in service: 1990–91

	Percentage Effect
Percentage differential associated with each break in service of 1 year or more	-2.87%**

Level of significance: *=.05, **=.01. The significance levels test whether these estimates are different from zero.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Undergraduate Major

Actual or perceived shortages of teachers in specific fields may have an effect on wages due to supply and demand factors; for example, periodically inflated demands for electrical engineers (or any particular occupation) create pressures that increase the cost for, or wages of, electrical engineers. The undergraduate majors of teachers, combined with indicators of the supply of and demand for teachers might provide indicators of teacher salary levels.

SASS provides several ways to identify potential gaps in the supply of teachers. First, the proportion of positions left vacant due to the lack of fully qualified applicants can be considered. Second, the degree to which classes are staffed with teachers holding temporary, provisional, or emergency certification can be measured. Third, the percentage of teachers assigned to teach subjects for which they are not specifically trained (out-of-field teaching) can be observed.

Salary differentials can be another indicator of teacher shortages. As suggested above, shortages in a field or subject area will tend to drive up the demand, and hence the salaries, of qualified teachers. Using the hedonic wage model described at the beginning of this report, this translates into additional wages being offered to teach subject areas in which shortages exist. To create this positive effect on wages, teacher shortages do not need to be real. Perceived shortages may often have the same effect. For example, educational policymakers are concerned that our schools do not have enough qualified mathematics and science teachers to prepare our youth for today's competitive global market (Darling-Hammond and Hudson 1990; Murnane and

[14] No correction is made for the length of the break in service since this information was not known.

Raizen 1988). Concurrently, the ongoing effort to provide an equitable education for all students has highlighted the need for special education programs and additional qualified teachers to work with students with disabilities. Consequently, additional wages might be expected to be paid for teachers who majored in mathematics, sciences, and special education.

The SASS Teacher Questionnaire asked respondents to indicate their undergraduate major from an extensive list. For teachers who received a bachelor's degree in education, the choices included education degrees with a focus in a particular subject area. For example, education majors may have focused on mathematics education, social science education, elementary education, or special education, among other subjects. Categories were provided for several different types of special education. The complete list of undergraduate majors included in the statistical analysis is included in the tables B.1 and B.2 in Appendix B where the results of the statistical analyses are presented.

Table 2.6 highlights the findings of the salary analysis for public school teachers in selected majors. The comparison group for this analysis is teachers who majored in elementary education (i.e., all findings are relative to what an elementary education graduate with similar personal and school characteristics earns). Three of the categories of education majors and four of the noneducation majors reveal any statistically significant relationship to teacher salaries. Of the education majors, only those teachers who majored in business education, vocational education, and physical education reveal any wage advantage. Among noneducation majors, those teachers who majored in mathematics, music, social sciences, and other miscellaneous subjects reveal a wage advantage.

As expected, teachers who majored in *mathematics* or *business* received about 3 percent more in salary than teachers who majored in *general elementary education*, all else equal. However, the wage differentials between teachers who majored in *mathematics education* or *business education* are smaller or not statistically significant, compared to similar teachers who came out of a mathematics department or business school, *all else equal*.

Wage advantages would be expected for teachers with natural science and special education majors.[15, 16] Presumably these teachers would be able to demand higher wages due to the perceived shortage of science and special education teachers. However, contrary to expectations, no such wage advantages are revealed. Teachers who majored in social science

[15] Included in the natural science category are majors in biological and life sciences, chemistry, geology, physics, and other natural sciences.

[16] The special education category combines teachers trained to work with nine specific disabilities and two general special education categories.

receive salaries about 2 percent larger than comparable teachers with general elementary education majors.[17] Almost a 5 percent wage advantage is also evident for physical education (PE) majors.

The results of the analysis of undergraduate majors indicate that at least some of the teachers who would appear to have better private labor market opportunities do show wage advantages, all else equal. Specifically, mathematics majors and those with knowledge and skills in vocational subjects and business receive higher salaries, all else equal. At the same time, some majors like social science, performing arts, music, and the “other miscellaneous” category also reveal wage advantages.[18] The wage advantages associated with physical education may be reflecting the opportunities for the extra pay associated with coaching school sports. Although the SASS data are not sufficient to explore this possibility fully, there is some evidence of this presented in Appendix A (*Technical Notes*) in the discussion of the *choice of dependent variable*.

Table 2.6— Salaries of teachers with selected undergraduate majors, as a percentage difference from general elementary education majors: 1990–91

(The cells of the table below reflect the percentage difference in salary earned by a teacher with the designated undergraduate major relative to a teacher who majored in general elementary education.)

Variables	Percentage Effect
Education majors:[a]	
Mathematics education	-0.54%
Business education	1.63*
Special education	0.84
Physical education	4.92**
Vocational education	3.02**
Noneducation majors:	
Foreign languages	-0.95
Business	2.92
Mathematics	2.37*
Music	4.03*
Natural science	0.44
Performing arts	2.60
Social science	2.17**
Other miscellaneous	9.53**

Level of significance: *=.05, **=.01. The significance levels test whether these estimates of salary differences are significantly different from those of a general elementary undergraduate major.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

[a] It is not clear that respondents to the SASS teacher questionnaire sorted themselves properly between noneducation and education majors in the same subject area.

[17] Social sciences include majors in economics, history, political science and government, sociology, psychology, public affairs and services, home economics, and other social sciences.

[18] The Aother miscellaneous@ category includes general studies, multidisciplinary studies, curriculum and instruction, education administration, counseling and guidances, educational psychology, and other education.

Level of Education (Highest Degree Earned)

Holding all other factors constant, how do teacher salaries vary with degree level? That is, does degree level contribute independently to differences in teacher salaries? Since level of education is factored into most teacher salary scales, one would expect a positive relationship between teacher salaries and degree level. To explore this relationship, the analysis uses six categories of higher education available in the SASS data; each category indicates the highest degree a teacher has earned. Since many teachers have accumulated college credit beyond the current highest degree level, and since salary contracts often take these additional credits into account along with degree level, the estimated wage advantage associated with highest degree level may tend to overstate the value any particular degree level. The bachelor's degree is used as a comparison category to determine how much more salary a master's, education specialist, or doctorate degree would be worth. Alternatively, having no degree or a 2-year associate of arts degree is expected to be associated with lower teacher salaries.

Table 2.7 presents the results of analysis. In general, the analysis shows that public school teachers with higher degree levels earn increasingly higher salaries, all else equal. Teachers with a master's degree earn more than 11 percent higher salaries than teachers with a bachelor's degree. Teachers with an education specialist certificate (usually requiring 1 or 2 years of education beyond a master's degree) receive about 14 percent higher salaries than those with a bachelor's degree, while teachers with a doctorate earn 17 percent higher salaries. There is no statistically significant difference in teacher salaries associated with having less than a bachelor's degree.

Table 2.7— Salaries of teachers by highest degree, as a percentage difference from teachers with bachelor's degrees: 1990–91
(Cells indicate the percentage difference in salaries earned by a teacher who has earned the designated degree relative to one who has earned a bachelor's degree.)

Variables	Public Sector School Teacher
No degree	1.41%
Associate of Arts	5.42
Bachelor's	*(Comparison Group)*
Master's	11.31**
Education specialist	13.88**
Doctorate	17.55**

Level of significance: *=.05, **=.01. The significance levels test whether these estimates are different from zero.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Teacher Certification

As described in the previous section, teacher salary schedules are typically based on longevity and educational preparation (e.g., degree level or hours of graduate credits earned). In many instances, some form of teacher certification serves as a prerequisite for employment and/or advancement on the salary scale (see Tryneski 1992). Based on the SASS Teacher Questionnaire, teacher certification is divided into five categories: advanced professional, standard, probationary, temporary, and no teaching certificate.[19] The analysis compares the salaries of teachers with each level of certification to the salaries of teachers who hold the "standard certificate," all else equal. If certification has a value in the labor market for teachers, higher levels of certification would be associated with higher salaries. For example, teachers with an advanced professional certificate would likely earn a higher wage than teachers with standard certificates; while teachers with probationary, temporary, or no teaching certificates would receive lower wages, all other factors equal.

Table 2.8 shows the percentage salary differential associated with each level of certification. The salary of teachers with a standard certificate is the base for comparison, since more than 77 percent of the public school teachers in the SASS sample hold a standard certificate. For public school teachers, the certification level *does* have the expected impact on salaries; that is, higher levels of certification are compensated in the public sector. An advanced professional teaching certificate is worth more than a 1 percent salary increment over a standard certificate. A teacher with no teaching certificate earns about a 3 percent lower salary level than teachers with a standard certificate. A probationary certificate is associated with more than a 2 percent salary decrement, while the temporary certificate is not significantly different from the standard certificate.

Teacher Effort

One dimension of teacher quality is the amount of effort teachers put into their jobs. Working beyond normal school hours providing additional services to students such as tutoring, coaching sports, or guiding an extracurricular activity is one way that teacher effort can be measured. Assigning homework to students and mentoring less experienced teachers also involve additional time and effort on the part of teachers. The SASS 1990–91 Teacher Questionnaire asks whether teachers put in additional hours for before- or after-school activities. The average teacher in both the public and private sectors spends more than 10 hours per week involved in before- or after-school activities. It is hypothesized that teachers who put extra time and effort into their jobs will be paid higher salaries, all else equal. That is, if these measures of effort are proxies for, or are associated with, unobserved characteristics related to teacher quality, a wage advantage would be expected.

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[19] The variable from which these certification categories are defined actually refers to certification in main field of assignment. The SASS questionnaires do not actually ask whether a teacher is simply certified or not.

Table 2.8— Salaries of teachers with different certificates, as a percentage difference from teachers with a standard certificate, by sector: 1990–91
(Cells indicate the percentage difference in salaries earned by a teacher who holds the designated teaching certificate relative to one who has a standard certificate.)

Variables	Public Sector School Teacher
Advanced professional certificate	1.25%**
Standard certificate	*(Comparison Group)*
Probationary certificate	-2.45*
Temporary certificate	-1.04
No certificate	-3.06**

Level of significance: *=.05, **=.01. The significance levels test whether these estimates are different from the standard certificate.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

The percentages in table 2.9 indicate that controlling for other factors, the salaries of public school teachers who spend additional hours in before- or after-school activities are greater than for those who do not. Each additional hour per week is worth about a .1 percent salary increment. For a teacher who spends more than 10 additional hours of effort per week, this would translate into a salary that is 1 percent higher for public school teachers.[20]

Table 2.9 also indicates that public school teachers who assigned homework in the most recent week had larger salaries than those that did not. Finally, public school teacher salaries show no relationship to whether the teacher is a mentor.

Table 2.9— Percentage increment in salaries of teachers per additional hour of effort, by sector: 1990–91

	Public Sector School Teachers
Nonschool time spent on sch related activities (hrs/wk)	0.11%**
Assigned homework in most recent week	1.51**
Is a mentor teacher	0.94

Level of significance: *=.05, **=.01. The significance levels test whether these estimates are different from zero.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

[20] For a further discussion of the impact of nonschool time on salary, see the discussion in Appendix A on the *choice of dependent variable*.

The Impact of the Job Environment on Teacher Salaries

Are teachers willing to trade off salaries to teach in more pleasant job environments? More pleasant job environments may include teaching smaller classes, higher achieving students, students with fewer family problems, and students subject to less violent or self-abusive behavior (e.g., students who do not abuse drugs or alcohol). Moreover, what role do teachers' levels of influence or control over their environment have in the salary determination process? And how is overall job satisfaction reflected in salary differentials? Each of these dimensions of the job environment and its relationship to teacher salaries is examined below.

High Achievers Versus Low Achievers

New and progressive educational programs have had a significant impact on the student mix within schools. School choice, even on a limited basis, has schools competing for the same students. Magnet schools attempt to attract students by offering special programs. In addition, district programs for gifted or high-achieving students or students "at-risk" are often offered in one or more locations within a district. What impact does the composition of students have on teacher salaries?

Using the SASS questionnaires, two variables were constructed: the percentage of time teachers spent teaching high-achieving students and the percentage of time teachers spent teaching low-achieving students. The results are displayed in table 2.10. The percentage of time spent teaching high-achieving students is positively associated with teacher salaries, all else equal, although the effect is extremely small. This could reflect the notion that high-achieving students represent more of a challenge for teachers, and thus, teachers require compensation for the additional effort. It could also reflect the notion that "better" teachers (at least in the eyes of decisionmakers) are more commonly assigned to high-achieving students. No statistically significant relationship appears between salaries and the percentage of time teachers spend with students they perceive to be low-achieving students.

Table 2.10— Percentage effect on teacher salaries of assignment characteristics: United States, 1990–91

Variables	Percentage Effect
High-achieving students	0.01%*
Low-achieving students	-0.00

Level of significance: *=.05, **=.01. The significance levels test whether these estimates are different from 100 percent of public sector salaries.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Social and Physical Work Environment

Table 2.11 presents the results of the analyses of teachers' perceptions of their working environment. The SASS Teacher Questionnaire presents a series of statements to which teachers are to indicate their level of agreement or disagreement. Each of these statements taps into teachers' perceptions of their social and physical work environments. Based on this list of more than 50 items, seven indices of the school environment were constructed using factor analysis. The list of items included in each of these seven indices is presented in Appendix A (*Technical Notes*) of this report.

Table 2.11— Percentage effect of teacher attitudes and perceptions on salaries: United States, 1990–91

Percentage difference in salary associated with a one standard deviation increase in the level of the teacher' perception of:	Percentage Difference in Teacher Salaries
Student self-abusive behavior	-0.33%
Violent student behavior	0.70**
Students' family problems	-1.00**
Support within the environment	-0.93**
Their control within the environment	0.31
Their influence in policy	0.58**
Job satisfaction	0.62**

Level of significance: *=.05, **=.01. The significance levels test whether these estimates are different from zero.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

The relationship between teacher salaries in these seven indices is intended to reflect the trade-off between salaries and working environment. One expects that, all else equal, teachers will implicitly receive compensation for working in more difficult environments. Alternatively, schools exhibiting more pleasant working environments, on average, will have less trouble recruiting teachers. Either way, one expects to find that, all else equal, teacher salaries will be higher in schools with less pleasant working environments. The values contained in the cells of table 2.11 are scaled to reflect the association between teacher salaries and a one standard deviation increase in the presence of the attribute described in the table.

A number of items referred to teachers' perceptions of the student population. This range of items asked whether students were highly motivated or dangerously violent, whether they have had home and family problems that have hampered their academic success, or whether they were involved in self-destructive behaviors such as absenteeism and/or drug abuse. This series of items was grouped into three composite indices: students with family problems, students with self-abusive behavior patterns, and violent student behavior (i.e., students who present a physical threat for themselves and their teachers). From the perspective of teachers (i.e., the supply side of the market), one would expect that teachers would require higher salaries to teach in environments in which students were more self-abusive, were more violent, and had more family problems. From the demand side, one would expect that these attributes would reduce the productivity of teachers and hence lower the salaries districts are willing to offer to teachers with any given set of characteristics. It may also have the effect of reducing the incentive of districts to employ higher quality, more costly teachers because their productivity level may be relatively lower in these environments. Thus, there is no way *a priori* to predict the direction of these effects, and this is especially true given that it is not clear that this analysis encompasses all of the relevant quality attributes of teachers.

The results presented in table 2.11 reveal no statistically significant relationship between the perception of student self-abusive behavior and teacher salaries. However, teachers who perceive higher levels of violent student behavior appear to receive statistically significantly higher salaries (i.e., 0.70 percent associated with a standard deviation difference in the index), all else equal. On the other hand, teachers who perceive higher levels of students' family problems receive statistically significantly lower salaries (i.e., -1.00 percent), all else equal. From a supply-side perspective, the effect of violent student behavior is what one expects to find, *a priori*, while the effect of students' family problems is counter-intuitive.

In addition to student characteristics, the series of items addresses issues concerning teachers' individual sense of control, influence, and support within their own teaching environment. From a supply-side perspective, one would expect that teachers would sacrifice wages, all else equal, to teach in environments within which they perceive higher levels of support, influence on policy, and sense of control. From a demand-side perspective, school officials may tend to use these characteristics of jobs as rewards for teachers they perceive to be highly productive. That is, the better teachers may be assigned to jobs or circumstances in which they tend to enjoy high levels of support, influence, and control. If all attributes associated with teacher productivity are not included in the analysis, one might observe higher wages being associated with these job characteristics.

The empirical results show that teacher salaries are negatively and statistically significantly associated with levels of support, which is consistent with the supply-side explanation. On the other hand, teacher salaries are positively and statistically significantly associated with levels of teacher influence on policy. That is, lower teacher salaries are associated with higher levels of teacher support and lower levels of teacher influence on policy. No statistically significant relationship is found between teacher salaries and the teacher's sense of control.

The relationship between teacher salaries and teacher satisfaction may be either positive or negative. From a demand-side perspective, more satisfied teachers are likely to be more productive and will garner higher salaries, all else equal. On the other hand, higher levels of satisfaction may tend to reflect more pleasant working conditions which from a supply-side perspective would suggest a negative association with salary: that is, the teacher would sacrifice wages, all else equal, to work in an environment in which there would be higher levels of satisfaction.

Based on a third group of items on the SASS questionnaire, an index of the teachers' overall or global satisfaction was constructed. The index included satisfaction with work and the characteristics of their work environment. The results show that for public school teachers, higher levels of teacher satisfaction are associated with higher salaries.

The results show that all of these factors have both supply- and demand-side effects. The equations that were estimated for this analysis represent a reduced-form structure that combines the impact of supply- and demand-side effects.

These characteristics and behaviors of students and their families are generally the types of variables that would be included in the calculation of teacher costs, which are presented in chapter 3. There are two reasons for not including them in the TCI in the present analysis. First, these measures are school-level measures rather than district-level measures, and the TCI is not calculated at the school level. The reason for this is that employment decisions are made at the district level, and district officials may choose to assign a teacher to a school with either a more difficult or challenging work environment.

Second, the measures used in this analysis represent subject perceptions of the individual teachers rather than objective measures of the work environment. It is important that the TCI not be contaminated by subjective data, but rather should rely as much as possible on objectively measured characteristics. The value of including these measures in the present analysis is to control for the effects of variations school-level characteristics and to illustrate what impact similar district level measures might have if they were available.

Class Sizes

Do teachers trade off wages to work in schools or districts with smaller classes? To test this hypothesis, a variable which represents an index of the teacher's class size was constructed. The index is an average across all of the classes taught by each teacher and represents the ratio of the individual teacher's class size(s) relative to the national average class size for all teachers in similar subject areas. That is, the class size of a physical education teacher is compared to those of all physical education teachers. Band teachers are compared to other band teachers; mathematics teachers are compared to other mathematics teachers.

The reason for this approach is that class sizes vary systematically with the subject area or the nature of the class. Elementary classes tend to be of different sizes than secondary classes, and band or chorus classes are different than English or mathematics classes. Thus, simply using class size would have confused the analysis.

The results reported in table 2.12 are consistent with the hypothesis that teachers do trade-off wages to work in schools or districts with smaller classes. Larger class sizes are associated with higher teacher salaries, although the results are statistically significant only in the public sector. Based on these results, a 50 percent difference in class size (e.g., moving from an average class size of 20 to 30 students) would be associated with a one-half of 1 percent salary increase in the public sector.

Table 2.12— Percentage difference in teacher earnings associated with larger class sizes: United States, 1990–91

	Percentage Effect
Effect of a 50 percent increase in class size	0.50%**

Level of significance: *=.05, **=.01. The significance levels test whether these estimates are different from zero.
Public sector effect = exp(0.0122*(ln(1.5)-ln(1.0)))
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Summary and Implications

This chapter presented information regarding the patterns of variation in the salaries paid to public school teachers in relation to various background, personal, and job characteristics.[21] For the most part, the factors examined in this chapter are within the control of local decisionmakers in the long run. This analysis isolates the aspects or attributes of teachers that schools compensate. It explores what school decisionmakers value in teachers and, hence, are willing to pay more to acquire. In essence, this analysis helps illuminate what is important and what matters about teachers from the perspective of school employers.

The interpretation of these effects suggests that both supply- and demand-side factors are working and that in some instances, they are not easily distinguished from one another. Both objective and subjective measures of the school and work environment have exhibited effects on salaries. In general, more difficult work environments are associated with wage premiums, all else equal. This suggests that providing similar teacher services to all types of students will require different salary levels for teachers.

Hedonic wage analysis illuminates some of the trade-offs, both implicit and explicit, that confront employees. The analysis goes beyond the characteristics that are formally rewarded in salary schedules, such as education and experience. In fact, one of the strengths of hedonic wage

[21] The foregoing analyses have also controlled for the characteristics of the regions and labor markets within which schools and districts compete for teachers' services. These regional and labor market factors and their implications for examining variations in teacher costs are discussed in more detail in a separate report.

analysis is that it includes both pecuniary and nonpecuniary rewards. Such an analysis shows the comparative worth of such attributes as obtaining a graduate degree, teaching smaller class sizes, working in disruptive schools, or putting in more after-school hours.

Increases in compensation are one of the market forces that establish balance. That is, shortages of particular types of teachers or in particular types of schools will be reflected by higher salaries. By isolating what factors are related to higher salaries, hedonic wage analysis illuminates potential areas of shortage in the teacher labor market.

Finally, hedonic wage analysis shows for which characteristics schools are willing to pay more, but it does not, however, show or indicate for which characteristics schools *should* be willing to pay more. It does not address the issue of *what ought to be* valued or compensated; it illuminates *what is* currently compensated.

What this chapter does not address are those factors that affect teacher salaries that are outside the control of local decisionmakers. The background and personal characteristics of teachers, as well as the jobs to which they are assigned, are ultimately within the discretion of local school officials. But what about those factors that affect teacher salaries that are defined by the local labor market or that affect the attractiveness of a particular district as a place to live and work? These are the factors that are examined in the next chapter.

Chapter 3

The Cost Factors: Regional and District Characteristics That Are Outside Local Control

The previous chapter examined the patterns of variation in teacher salaries related to personal, job/classroom, and school characteristics (i.e., variables T_i, C_i, and S_i in equation 1) that are within the control of local school decisionmakers. These are the factors over which decisionmakers have some discretion or choice. The present chapter examines the patterns of variation in teacher salaries associated with the *cost factors* (i.e., the variables R_j and D_j in equation 1) while controlling for the effects of the *discretionary* factors. How do teacher salaries vary with factors outside local control?

> *How much more or less does it cost in different jurisdictions to recruit and employ school personnel with similar characteristics?*

These cost factors encompass variations in the costs of living, competitiveness of the labor markets, the composition of students by racial-ethnic background, levels of crime, the quality of the weather, the availability of alternative job opportunities, and other attributes of the regions and districts which affect their attractiveness as places to live and work. It is anticipated that less attractive jurisdictions will have to pay relatively higher salaries to attract teachers. A district in a region with high *cost factors*, but which has low fiscal capacity (i.e., low property wealth or low income residents), may not be able to recruit teachers with the high qualifications that they might otherwise desire. A similarly situated district with high fiscal capacity will be able to access the higher tax revenues necessary to pay teachers the higher salaries required by the market to compensate them for the high cost factors.

Highlights of the variations in teacher salaries in relation to the *cost factors* are presented below.

- **Competition in the market for teachers**. *Counties with highly competitive labor markets for teachers exhibit salaries as much as 8 percent higher. In addition, counties with tighter overall labor markets as reflected in lower unemployment rates also exhibit higher teacher salaries.*

- **Factors underlying cost-of-living differences.** *Factors associated with higher costs of living such as higher land prices and faster growth in population are also associated with higher teacher salaries.*

- **Amenities of urban and rural life.** *In general, more densely populated areas and the larger urban areas exhibit significantly higher teacher salaries. One standard deviation above the mean in metropolitan area population is associated with a 6.5 percent salary differential. The analysis reveals higher teacher salaries in areas with higher crime rates.*

- **Climatic conditions.** *Teachers appear to give up salaries to work in regions with warmer climates (as measured by mean temperatures) and/or less annual snowfall.*

The analysis in this chapter presents the patterns of variation in teacher salaries associated with the district- and regional-level *cost factors*. The magnitudes of the salary differentials displayed in this chapter are based on the coefficients of the *cost factor* variables (D_j and R_j) included in equation (1) in chapter 1 of this report. These coefficients will subsequently be utilized to estimate a teacher cost index (TCI) in chapter 4. The TCI reflects the relative magnitudes of the overall teacher cost differences across local jurisdictions. The same teacher salary equation (appendix B, table B.2) used to estimate the wage differentials associated with the *discretionary factors* discussed in chapter 2 is used to estimate the wage differentials associated with the *cost factors* presented in this chapter. The regional- and district-level factors affecting teacher costs are presented in separate sections below.

Regional-Level Factors

Each of the regional-level factors is discussed below. The reader must keep in mind that each of these discussions reflects the patterns of differences associated with each variable taken independently of the other variables in the analysis—that is, holding *all else equal*. The coefficients when taken together (e.g., through calculation of a teacher cost index) may yield different patterns than they do when examined one at a time. It is the combined patterns that matter for calculation of overall teacher cost differences.

In assessing regional effects on teacher salaries, it is necessary to define what constitutes a region for specific variables. In most cases, county boundaries are used to define the region in part because this is the way certain data items are available in existing data sources. For most variables, county boundaries are preferable to district boundaries since many teachers live outside of the districts in which they are employed. The size of a metropolitan area is defined in terms of the population of the multiple counties included within the metropolitan area. Climatic regions are defined in terms of the closest weather reporting station for each district.

Competition in the Market for Teachers

It is hypothesized that the more local competition between districts for teachers, the higher would be the wages of teachers. While labor markets are not necessarily defined by political jurisdictions, the measure of competition used the county as a first approximation to define the geographic boundaries of the local labor market. The variable used to measure competition was the percentage of public school enrollment accounted for by the largest district in the county. For example, if a county has only one district, then 100 percent of the enrollment in the county attends a single district. If a county has five districts, but one district enrolled half of the children in the county, then the variable would take on the value of 50 percent. This variable reflects both information about the number of potential competitors as well as the power of the largest employer in the county. The notion underlying this variable is that if one district is so large within a given geographic area, it has significant control over the process of wage determination. It possesses what economists call monopoly power in the labor market.[22] This monopoly power results in fewer choices for local teachers and hence lower wage levels being set by the dominant district than would otherwise exist.

The empirical analysis reveals the expected effects. Table 3.1 presents an index which indicates the difference in teacher salaries in a one-district county versus counties in which increasingly smaller percentages of county enrollment are accounted for by the largest district. The coefficient of this variable, which is highly statistically significant, indicates that, all else equal, teacher salaries in a county where 50 percent of county enrollment is in a single district are approximately 4.1 percent higher than those in one-district counties. Where the largest district accounts for 25 percent of county enrollment, teacher salaries are 6.2 percent higher than the one- district county. Where the largest district accounts for 10 or 5 percent of enrollment, teacher salaries are 7.5 and 7.9 percent higher than in one-district counties.

Table 3.1— A comparison of teacher salaries in counties with varying levels of competition in the market for teachers as measured by the percentage of total enrollment in the county, accounted for by the largest district in the county, 1990–91

Percentage of total county enrollment accounted for by largest district in county	Index of Teacher Salaries
100% of county enrollment (a one-district county)	100.0 (*Comparison Group*)
50% of county enrollment	104.1**
25% of county enrollment	106.2**
10% of county enrollment	107.5**
5% of county enrollment	107.9**

Level of significance: *=.05, **=.01. The significance levels test whether these estimates are different from the comparison index value of 100.0.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Distance from Central Cities

Following standard arguments in urban economics, it is hypothesized that within a metropolitan area, *all else equal*, districts further from the central business district would tend to pay lower salaries due to lower local costs of living associated with lower land values and hence housing costs away from the central city. The impact is that the lower costs of living tend to permit lower wage levels, all else equal, within the metropolitan area for those working in the local public services, like education. Although there are many complicating factors, this is the general pattern of wage variation one expects in the traditional urban area with one central business district located at the center.

[22] Monopoly power in the labor market is formally referred to as monopsony.

At the same time, however, as one moves to districts located in more remote rural areas, other factors must be considered. Districts that are further away from the centers of urban life and the cultural and other amenities associated with urban living (access to medical facilities, shopping facilities, and employment opportunities) might have to pay higher salaries, all else equal, in order to attract comparable teachers. That is, while costs of living may be high in urban areas, there are also some efficiencies to be gained by living in urban areas in terms of access to certain kinds of goods and services.

The results presented in table 3.2 show that within the distances typically covering a single metropolitan area, there are virtually *no* statistically significant difference in salaries according to the distance of the district from the central city. However, in the more rural districts that are more than 160 miles (a drive of about 3 hours or more) from the nearest central city, teacher salaries are about 6.3 percent higher than those of districts located in metropolitan areas, all else equal. Thus, the remoteness of the district does have a positive impact on teacher salaries, all else equal.

Table 3.2— A comparison of teacher salaries in districts that are varying distances from the closest central city, 1990–91

District location in comparison to closest central city	Index of Teacher Salaries
Closest central city is:	
<= 10 miles away	100.0 (*Comparison Group*)
> 10 and up to 20 miles away	99.8
> 20 and up to 40 miles away	100.3
> 40 and up to 80 miles away	100.8
> 80 and up to 160 miles away	101.7
> 160 miles away	106.3**
Number of central cities less than 75 miles from district:	
1 central city	100.0 (*Comparison Group*)
2 central cities	99.5
3 central cities	102.2**

Level of significance: *=.05, **=.01. The significance levels test whether these estimates are different from the comparison index value of 100.0.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

The analysis also shows that districts within 75 miles of three central cities pay higher teacher salaries by about 2.2 percent, all else equal. This could reflect more competitive labor markets or higher costs of living in larger metropolitan areas with multiple business centers.

Costs of Living and the Characteristics of Urban Life

Table 3.3 displays a series of variables that are commonly associated with variations in the cost of living across regions and/or differences in the characteristics of urban life. In each case, teacher salary differences are expressed as an index which compares teacher salaries at various values of each independent variable. The index is set at a value of 100.0 for the mean value for each specific independent variable. Each of the variables listed in table 3.3 are discussed below.

Two variables that underlie regional variations in the costs of living are included in the equation: the percentage change in the population of the county over the past decade (1980 to 1990) and the base price of land as reflected by the average value of farm land and buildings per acre.[23] Changes in the population affect local demand for goods and services and reflect upward pressures on local prices and hence costs of living. The results suggest that a one standard deviation increase in the percent growth rate in population over the preceding decade (from 12 percent growth to 30 percent growth) is associated with approximately a 1.6 percent teacher salary differential, all else equal.

The value of farm land per acre is used here to reflect the base price of land within a region (i.e., the price of the cheapest land in a county or metropolitan area). Basic land values affect the local costs of producing goods and services and hence the cost-of-living differences across regions. A one standard deviation increase in the base price of land (i.e., which is approximately a 103 percent increase) is associated with 4.1 percent higher teacher salaries, all else equal. A 50 percent decline in the base price of land is associated with a 3.9 percent lower level of teacher salaries (i.e., an index of 96.1 compared to 100 at the mean).

[23] For a discussion of these explanatory variables and their impact on variations in the cost of living, see McMahon (1994) and McMahon and Chang (1991).

Table 3.3— A comparison of teacher salary differences associated with independent variables reflecting differences in the cost of living and the characteristics of urban life, 1990–91

Description of independent variable	Index of Teacher Salaries
Percentage change in county population from 1980 to 1990	
6 percent decline (-1 std deviation)	98.4**
12 percent increase (mean value)	100.0
30 percent increase (+1 std deviation)	101.6**
Price/acre of agricultural land	
$652 per acre	96.1**
$1,324 per acre (mean value)	100.0
$2,697 (+1 std deviation above)	104.1**
County Population Density (Mean=347, Std Dev=1,775)	
50 residents per square mile	102.7**
200 residents per square mile	100.3**
347 residents per square mile (mean density)	100.0**
2,122 residents per square mile (1 std dev above mean)	101.4**
10,000 residents per square mile	105.7**
Population of the MSA/PMSA if metropolitan area or county population if nonmetropolitan area	
1,000 residents	96.6**
9,347 residents	94.9**
50,000 residents	95.8**
445,453 residents (mean value)	100.0
1,000,000 residents	102.4**
2,928,497 residents (1 std dev above mean)	106.5**
Percent Unemployment Rate	
3.2 percent (-1 std dev below mean)	101.1**
5.6 percent (mean value)	100.0
8.0 percent (1 std dev above mean)	98.9**
Number of banks per 100,000 population in county	
3.8 banks per 100,000 (-0.5 std dev below mean)	101.4**
8.7 banks per 100,000 (mean value)	100.0
18.5 banks per 100,000 (+1 std dev above mean)	97.3**
Number of violent crimes per 10,000 population in county	
9 violent crimes per 10,000 (-1 std dev below mean)	98.5**
58 violent crimes per 10,000 (mean value)	100.0
107 violent crimes per 10,000 (+1 std dev above mean)	101.5**

Level of significance: *=.05, **=.01. The significance levels test whether these estimates are different from the mean index value of 100.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91

The results of the analysis indicate that districts located in more densely populated counties, and counties located in larger metropolitan areas, pay higher salaries to teachers. These results are highly statistically significant and are most likely associated with the higher costs of living in metropolitan areas or the higher wages that may result from urban crowding and other related disadvantages of living in urban areas. In fact, both density and population of the counties or metropolitan areas exhibit a curvilinear relationship with salaries, all else equal. As the table shows, the counties with the lower density levels (below the mean) and the smallest counties exhibit somewhat higher-than-average costs. Counties with a population density of 50 residents per square mile pay salaries of about 2.7 percent higher than counties at the mean density (i.e., of 347 residents per square mile). Teacher salaries decline moving from low density counties to counties with approximately the mean density. Highly urbanized areas with a density of 10,000 residents per square mile are associated with a teacher salary differential of almost 6 percent. For county/metropolitan area population, teacher salaries move from an index of 96.6 at population of 1,000 down to 94.9 for a population of 9,347, which is the population at which the minimum teacher salary index is reached with respect to population. As the county/metropolitan area population increases beyond 9,347, the teacher salaries are higher and reach and index of 106.5 (i.e., a 6.5 percent increment) at a population of almost 3 million residents.

Higher rates of violent crime (i.e., the number of violent crimes per 10,000 population) in the county are also associated with higher teacher salaries. This result is consistent with the notion that teachers are implicitly paid compensating differentials to work in districts located in counties with higher levels of violent crime. Moving from a county with a violent crime rate one standard deviation below the mean (9 incidents per 10,000 population) to a county with a violent crime rate one standard deviation above the mean (i.e., 107 incidents per 10,000 population) is associated with a 3 percent increment in teacher salaries.[24]

To reflect the level of commerce and financial activity within a region, the analysis included the number of banks per 100,000 population in the county. This variable appeared to have a negative impact on teacher salaries. Teachers would trade off salaries to be located in areas with greater levels of commerce and trade. Moving from a county where the number of banks is at the mean of 8.7 per 100,000 population to a county that is one standard deviation above the mean (i.e., at 18.5 per 100,000) is associated with a 2.7 percent lower level of teacher salaries.

Finally, these results indicate that higher levels of unemployment in an area are associated with lower teacher salaries. Higher levels of unemployment imply that there may be greater difficulty in obtaining alternative employment. This would tend to have a depressing effect on teachers as well as other occupational salary levels in the market. An increase in the unemployment rate from the mean of 5.6 percent to 8 percent is associated with a 1.1 percent lower level of teacher salaries.

[24] This 3 percent is derived by taking the ratio of the two indices presented in table 3.3. That is, 101.5/98.5 = 103.0 which implies a 3 percent higher salary level, all else equal.

Climatic Conditions

Previously, literature exploring the quality of life has included measures of climatic conditions.[25] The notion is that individuals would trade off salaries to live and work in regions with more favorable climates. In this nationwide study of teacher salaries, two measures of climatic conditions are included in the analysis: the 30-year normals for the mean temperature and the average inches of snowfall for the region. As expected, teacher salaries are negatively associated with mean temperature and positively associated with snowfall. That is, teachers would give up salary to live in areas with warmer climates (i.e., higher mean temperatures) and lower levels of snowfall. Moving from a region with a mean temperature of 57 (i.e., the sample mean value) to a region with a mean temperature of 65 is associated with a 2.8 percent lower level of teacher salaries, all else equal. Moving from a region with no annual snowfall to a region with the mean value of annual snowfall of 21 inches is associated with a 2.3 percent higher level of teacher salaries, all else equal.

These results do not often show up in single-state studies where the variations in mean temperatures and snowfall are often not large enough to reveal statistically significant results. In this nationwide analysis where variations across local jurisdictions are substantial, the hypothesis about the effects of climatic conditions is borne out.

Table 3.4— A comparison of teacher salary differences associated with differences in climatic conditions, 1990–91

Description of independent variable	Index of Teacher Salaries
Climate	
30 year normal mean temperature (24 hours):	
49 degrees (1 std dev below mean)	102.8**
57 degrees (mean value)	100.0
65 degrees (1 std dev above mean)	97.2**
30 year normal annual snowfall:	
0 inches per year (approx. -1 std dev below mean)	98.7**
21 inches per year (mean value)	100.0
43 inches per year (1 std dev above mean)	101.3**

Level of significance: *=.05, **=.01. The significance levels test whether these estimates are different from the mean index value of 100.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

25 See, for example, Rosen (1977).

District-Level Factors

The district-level factors include district size, enrollment growth, and the racial-ethnic make-up of the enrollments. The results presented in table 3.5 show that districts of varying sizes pay systematically different salaries to teachers, all else equal. However, of the remaining district factors, only the percentage of Asian and Pacific Islanders is positively and significantly related to teacher salaries. These district-level factors include the additional variables that differentiate the district- from the regional-level TCI presented in subsequent tables.[26]

Similar to the other tables in this chapter, the relationship between teacher salaries and the district-level factors is expressed in the form of an index. For district size, the index value of 100.0 is assigned to the *comparison group* which in this case is districts with enrollment less than 500 students. In the case of the other variables (i.e., percent minority students by racial-ethnic background and percent enrollment growth in the last year), the index value of 100 is assigned to the mean value of each of the variables.

Racial-Ethnic Mix of Students

The association between high concentrations of minority students and teacher compensation has been the focus of much debate. It has been suggested that high proportions of minority students may be viewed as a negative working condition by a predominantly white teacher population (see Antos and Rosen 1975; and Chambers 1981a). If this is true, one would find that districts serving higher proportions of minorities will be observed to pay higher teacher salaries, all else equal. Alternatively, for a given salary level, it implies that districts with lower proportions of minorities will be in a relatively more favorable position to recruit "better" teachers in the labor market. Again without being sure that one has captured all of the elements of teacher "quality" in this analysis, it is difficult to sort out the extent to which the results reflect a supply (an undesirable working condition) or demand-side (teacher quality) difference.

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[26] One district-level factor that is not discussed in this analysis is the impact of unionization. Unfortunately, the database does not contain sufficient data to assess the impact of unionization. The only variable that may perhaps reflect some element of the union effect is one which designates a teacher as a member of a professional teacher or education association. The overall impact of membership in a professional teacher or educational association appears to be positive and statistically significant. The differential amounts to about 3.4 percent for public school teachers. What does this differential represent? Does this represent the effects of unionization? It is likely that most of the professional teacher or educational organizations in which teachers indicate membership would be accounted for by the state affiliates of the National Education Association (NEA) or the American Federation of Teachers (AFT). The presence of these associations and larger proportionate membership may tend to be positively associated with the existence and success of collective bargaining. This estimate of the differential is in the range associated with bargaining effects on salaries (e.g., see Chambers 1977). However, Chambers (1977) shows that for the most part the impact of teacher bargaining results from spillover effects. Chambers' results suggest that bargaining effects on salaries are less a result of what specifically happens in any given district than they are based on the overall coverage of teachers in a region. The larger proportions of teachers in a region or county who are covered by bargaining contracts, the higher the wages. Unfortunately, these results are somewhat difficult to explain since a separate analysis of private school teacher salaries showed an even larger effect of the variable membership in professional teacher or education associations. While it is recognized that some private school systems do negotiate with union representatives, there are no data of which the author is aware that indicate the extent of private sector bargaining for teachers. Further research needs to be done on this component.

Table 3.5— A comparison of teacher salary differences associated with district-level characteristics, 1990–91

Description of independent variable	Index of Teacher Salaries
District Size	
< 500	100.0**
501-1,000	105.9**
1,001-5,000	110.9**
5,001-10,000	113.6**
10,001-25,000	112.5**
25,001-50,000	111.0**
50,001-100,000	109.0**
>100,000	112.9**
Racial-ethnic composition of students	
Percent students who are Asian/Pacific Islander	
3.7 percent (mean value)	100.0
10.2 percent (+1 std dev above mean)	101.4*
Percent students who are black	
16.2 percent (mean value)	00.0
36.6 percent (+1 std dev above mean)	99.4
Percent students who are Hispanic	
12.0 percent (mean value)	00.0
30.6 percent (+1 std dev above mean)	100.9
Percent students who are American Indian/Alaskan Native	
1.7 percent (mean value)	100.0
5.5 percent (+1 std dev above mean)	100.2
Percent growth in district enrollment 1989/90 to 1990/91 school year:	
1.9 percent (mean value)	100.0
10.1 percent (+1 std dev above mean)	100.7

Level of significance: *=.05, **=.01. The significance levels test whether these estimates are different from the mean index value of 100.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

To test hypotheses about the impact of the minority composition of students on salaries, both district and school-level percentages of Asian and Pacific Islanders, blacks, Hispanics, and American Indian/Alaskan natives were included in the teacher salary equations. Moreover, the analysis accounted for the possible interactions between the composition of the students and the racial-ethnic background of the teacher. It was presumed that teachers of a particular racial-ethnic background would not be averse to teaching in schools or districts with high percentages of students with the same racial-ethnic origin.

Based on the analysis presented in this report, the evidence that compensating differentials are being received by teachers working in schools or districts with high percentages of minority populations is not strong. At the school level, only the percentage of Hispanic students is statistically significant and positively related to salaries. The other parameter estimates are not statistically significantly different from zero. At the district level, only the percentage of students who are Asian or Pacific Islanders is positively associated with teacher salaries. The interactions between teacher and student racial-ethnic origin suggest that teachers who are Asian and Pacific Islanders were actually willing to give up wages to teach in schools with a racial-ethnic student population similar to their own. None of the other interaction effects are statistically significant.

These results on minority composition of students and the results on the effects of teacher attitudes and perception of student behaviors, suggest that the racial-ethnic status of the students matters less than the behaviors of students. That is, teachers may not require compensating differentials to teach in high minority areas, but they may require compensation to teach in areas with poor student behavior or students with family problems.

The lack of strong impact of student racial-ethnic background on teacher salaries may also reflect a *balance* between the number of teaching positions in districts with high proportions of minority students and the number of teachers who are not averse to teaching in these circumstances. The implicit prices estimated in the hedonic wage model reflect the implicit price necessary to recruit the last teacher into a district exhibiting a certain set of characteristics. One would expect that in any given pool of teachers there are some who would either prefer or have no strong preferences against teaching in districts with high proportions of minorities. If the demand for teachers by districts with high percentages of minorities does not exceed the supply, then one would not expect to observe a wage differential associated with the percentage of minority students. Only if the demand for teachers in these types of districts exceeds the number of available teachers, then it will be necessary for districts to raise salaries or provide preferable working conditions to any additional teachers they need to employ.

District Size and Growth

To a point, district size tends to be positively associated with teacher salaries. It reaches a maximum of about a 13.6 percent salary differential in the size range of 5,000 - 10,000 students where the comparison group is districts with less than 500 students. Numerous arguments can be made about the impact of district size on the work environment. Larger districts tend to be located in larger metropolitan areas and are often more impersonal places to work. The larger districts may provide less opportunity for given teachers to have a significant impact on their own work environment. All of these factors are at one level or another reflected in other variables already accounted for in this analysis (e.g., through the teacher perception or attitudinal variables described in chapter 2 or the regional variables described earlier this chapter). Yet, above and beyond these variables, larger districts still tend to pay statistically significantly higher salaries than the smaller districts.

It was hypothesized that districts with growing enrollments would require an increasing share of the local market for teachers and that this growing demand for teachers would tend to be associated with higher salaries. The parameter estimate for this variable is not statistically, significantly different from zero, although it did exhibit a positive value.

Summary

This chapter has examined the relationship between teacher salaries and a series of regional- and district-level factors all of which are outside the control of local decisionmakers. The differences in teacher salaries associated with these variables are *cost differences*. They reflect the variations in salaries paid to comparable teachers working in similar job assignments across local school systems. All else equal, larger districts in more urbanized settings tend to pay higher teacher salaries. In addition, districts located in faster growing regions, regions with climates characterized by colder temperatures and greater quantities of snowfall, and regions with higher rates of crime pay higher salaries to teachers, holding all else constant. At the same time, districts in more remote regions pay somewhat higher-than-average salaries to compensate for reduced access to some of the amenities of living in more urbanized areas.

The next step in this analysis is to organize all of these factors into a comprehensive index of the variations in the cost of teacher services. The next chapter illustrates how this calculation is made and examines the overall patterns of variation in teacher costs in relation to certain district and regional characteristics.

Chapter 4

Development of a Teacher Cost Index and Comparisons with Alternative Models

Chapter 2 presents the patterns of variation in teacher salaries related to the *discretionary factors*, i.e., the factors within the control of local decisionmakers. Chapter 3 presents the patterns of variation in teacher salaries associated with the *cost factors*, i.e., the factors outside the control of local decisionmakers. A teacher cost index is designed to determine how much more or less different districts pay for comparable teachers assigned to similar job situations. The teacher cost index or TCI simulates the variations in teacher salaries resulting from variations only in the *cost factors*, while controlling for variations in the *discretionary factors*.

As suggested in chapter 3, the *cost factors* are divided into two types of variables: regional- and district-level variables. The regional variables describe the larger regions within which one or more districts operate. For the purposes of the present analysis, most, though not all, of the regional variables are measured at the county level. For some of the variables, a region is defined as the larger metropolitan area. The climatic variables are defined in terms of the closest weather reporting station. In general, it is observed that the regional *cost factors* taken individually are highly statistically significant, while only district size and one of the race-ethnic percentages among the district-level factors exhibit statistically significant coefficients. For this reason, two separate TCIs are calculated and presented in this analysis. The regional- and district-level TCIs are defined as follows:

- **The regional-level TCI** is calculated for each district, but only the regional variables are included in the determination of the index value. Thus, all districts within the same region will have the same regional-level TCI.

- **The district-level TCI** includes the variations in teacher costs associated with **both** the regional- and district-level variables in the determination of the index value. In this case, each district will have a unique value.

The TCI is calculated based on the parameter estimates derived from equation 1.1 (see chapter 1). Using the log-linear equation, it is straightforward to demonstrate that a TCI can be calculated using only the estimated coefficients and values of the *cost factors*, i.e., the independent variables that are outside local control. The district-level factors are represented by the letter D in equation 1.1, while the regional-level factors are represented by the letter R in equation 1.1. The expression utilized to calculate the regional- and district-level TCIs are displayed below in equations 4.1 and 4.2.[27]

[27] For a more detailed derivation of this equation, see Chambers (1981a).

(Eq. 4.1) TCIREG = the regional TCI (regional-level factors only):

$$TCIREG_j = \exp[\,\hat{\beta}_R \bullet (R_j - \overline{R})]$$

(Eq. 4.2) TCIDIST = the district TCI (combined regional and district-level factors):

$$TCIDIST_j = \exp[\,\hat{\beta}_D \bullet (D_j - \overline{D}) + \hat{\beta}_R \bullet (R_j - \overline{R})]$$

where $\overline{D}$ and $\overline{R}$ are the average values of district and regional characteristics. The Greek letters (*beta* with subscript *D* and *R*) correspond to the coefficients (parameter estimates) corresponding to each of the respective variables included in D and R. Even though only the variables representing the cost factors are included in calculating the index of teacher costs, it is essential to include the personal and job assignment characteristics in the salary analysis in order to control for the effect of these other factors on patterns of variations in teacher salaries. The TCI above reflects only the *cost factors*, controlling for the factors within local control. Notice that the regional-level TCI (i.e., $TCIREG_j$) above includes only the regional characteristics in the calculation of the index, while the district-level TCI (i.e., $TCIDIST_j$) above includes both regional- and district-level characteristics in the calculation of the index.

In general, the effects of many of the cost factor variables are examined together. This is a case in which the whole is more significant than the sum of the parts. This, in part, results from the intercorrelation among some of the variables that sometimes reduces one's ability to isolate independent effects.

The first section of this chapter presents average values of the TCI for each state. The second section presents the patterns of teacher cost differences according various characteristics of individual teachers. In each case, both the regional- and district-level TCI are presented. Standard errors for these index values are presented in corresponding tables in appendix C of this report. The third section presents a comparison of alternative models for analyzing teacher costs. The TCI developed in this paper is compared to an alternative and simpler model developed by Barro (1992) and to a cost-of-living adjustment proposed by McMahon (1994) and McMahon and Chang (1991). For the purpose of comparing these alternative indices, each index was rescaled in such a way that the average student was located in a district with an index of 100. Stated another way, this rescaling of each index was done so that the weighted average value of each index (i.e., the regional- and district-level TCI, the Barro index, and the McMahon Change cost-of-living index) is equal to 100, where district enrollment was used as the weight. All of the tables presented in this chapter reflect this rescaling of the indices.

Teacher Cost Differences by State

Table 4.1A presents the state-by-state estimates of the regional-level TCI. Table 4.1B presents the state-by-state estimates of the district-level TCI. Each of these tables designates the number of districts for which data are included, along with the weighted mean, standard deviation, and minimum and maximum values of the index for each state.

The overall mean value for both of the TCIs for the United States is 100.[28] Using the regional-level TCI, costs vary from a low of 53 to a high of 137. This means that teacher costs in the lowest cost region are 53 percent of those faced by the district serving the average student. The highest cost district pays 37 percent higher teacher costs than the district serving the average student. The lowest cost county is located in South Dakota, while the highest cost county is located in Alaska. Another way of looking at these numbers suggests that the districts in the highest cost regions of the country pay over two and one-half times as much to place comparable teachers in comparable classrooms and schools as districts in the lowest cost regions of the country (i.e., 137.37/53.49 = 2.56). The standard deviation of the TCI is 12 percent; that is, most of the districts are within plus or minus 12 percent of the average. While the range is slightly wider for the district-level TCI, the patterns of variation are quite comparable to the regional-level TCI.

The five states with the highest average teacher costs are, in order, New York (114.82), Massachusetts (114.06), Connecticut (113.80), Alaska (113.56), and New Jersey (113.02). Five of these states are located in the northeastern portion of the United States. The standard errors of the state-wide average index values are below one percentage point for all but 13 states.[29] With the exception of Alaska, the standard errors of the five highest cost states range from .6997 in Connecticut to 1.3580 New York. The standard error for the state-wide average in Alaska is 2.1859. The standard error is higher for districts further away from the overall average. With these standard errors, it is fairly safe to say that the differences among the top five states are not statistically significant.

[28] The actual overall mean value of the TCI using weighted averages of the cost factors is 101. This weighted mean value deviates from 100 because of the different weighting structures used for calculation of the regression estimates as opposed to the index values. The regression equations were estimated using the sample teacher weights. The TCI values were calculated for each district relative to the district attended by the average student. Thus, the mean values of the regional- and district-level cost factors were weighted by the enrollment levels of the district. Since comparisons among two other alternative teacher cost indices will be made in this chapter, it was necessary to rescale the TCI values so that the weighted average cost index is equal to 100. All of the indices to be compared later in this chapter will be rescaled in the same fashion. Thus, all of the indices in this chapter will have an index of 100 for the district serving the average public school student in the U.S.

[29] These standard errors are presented in Appendix C of this report.

Table 4.1A— State-by-state estimates of the regional-level teacher cost index (TCI)

State	Number of districts	Descriptive Statistics on Regional-Level TCI: Total enrollment	Mean	Standard deviation	Minimum	Maximum
U.S.	**14,494**	**40,116,027**	**100.00**	**11.67**	**53.49**	**137.37**
Alaska	36	94,330	113.56	7.97	96.28	137.37
Alabama	129	725,115	88.27	5.37	75.74	97.11
Arkansas	322	431,490	87.22	4.14	78.12	96.97
Arizona	205	630,816	97.07	6.90	84.37	106.45
California	991	4,813,643	109.39	7.60	77.35	118.71
Colorado	176	573,985	99.26	7.64	71.10	116.05
Connecticut	160	453,468	113.80	3.91	103.04	118.26
District of Columbia	1	80,694	106.62	0.00	106.62	106.62
Delaware	16	96,384	102.08	4.22	95.91	106.02
Florida	67	1,862,185	94.91	5.42	78.79	106.55
Georgia	184	1,150,172	91.70	8.82	70.73	105.89
Hawaii	1	159,285	92.49	0.00	92.49	92.49
Iowa	429	483,176	90.28	4.68	76.42	98.15
Idaho	110	217,555	93.86	4.68	72.29	102.25
Illinois	942	1,795,477	106.76	13.11	71.62	119.69
Indiana	295	937,324	97.74	6.30	80.32	106.36
Kansas	302	436,494	87.77	7.61	58.40	98.80
Kentucky	176	630,091	89.22	5.51	76.22	98.67
Louisiana	65	774,724	84.57	3.88	74.40	91.71
Massachusetts	269	730,024	114.06	3.77	87.62	119.55
Maryland	22	669,620	103.84	5.68	85.98	111.61
Maine	215	208,599	103.94	4.39	94.83	110.93
Michigan	552	1,560,809	105.34	7.54	85.99	115.36
Minnesota	429	751,268	98.89	8.92	73.12	110.60
Missouri	538	805,029	94.59	8.99	71.12	107.36
Mississippi	149	491,684	83.86	3.79	73.60	90.83
Montana	503	148,411	93.92	5.21	76.32	118.64
North Carolina	133	1,084,489	92.91	5.07	80.25	100.61
North Dakota	262	117,531	89.19	5.25	67.86	111.33
Nebraska	728	269,106	89.87	6.87	58.41	117.92
New Hampshire	148	163,778	108.71	3.94	100.54	112.95
New Jersey	534	1,007,162	113.02	4.46	96.01	119.39
New Mexico	86	296,471	90.34	5.17	73.74	96.91
Nevada	17	201,316	94.90	4.13	86.79	108.15
New York	627	2,361,043	114.82	12.70	88.98	128.82
Ohio	610	1,766,733	102.06	6.51	83.39	112.85
Oklahoma	586	568,711	86.60	4.31	68.32	94.92
Oregon	292	483,507	100.42	6.49	71.54	108.49
Pennsylvania	499	1,629,157	105.97	8.04	86.27	119.83
Rhode Island	36	136,086	110.76	1.73	107.51	112.05
South Carolina	80	451,308	90.00	5.89	79.02	102.30
South Dakota	172	125,316	87.08	4.39	53.49	92.49
Tennessee	132	819,229	90.29	4.78	76.59	97.75
Texas	1,042	3,380,805	92.66	8.26	70.10	106.29
Utah	40	444,832	96.58	4.40	73.22	109.65
Virginia	129	984,702	95.96	8.20	74.63	108.41
Vermont	236	90,215	101.42	2.67	94.54	107.75
Washington	294	810,011	105.84	9.10	75.08	116.33
Wisconsin	424	796,114	98.76	6.69	85.09	108.69
West Virginia	54	318,577	86.01	3.01	77.80	92.91
Wyoming	49	97,976	87.99	4.44	78.29	107.29

SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table 4.1B— State-by-state estimates of the district-level teacher cost index (TCI)

		Descriptive Statistics on District-Level TCI				
State	Number of districts	Total enrollment	Mean	Standard deviation	Minimum	Maximum
U.S.	**14,463**	**40,114,083**	**100.00**	**13.12**	**47.86**	**139.22**
Alaska	36	94,330	113.68	8.68	88.70	139.22
Alabama	129	725,115	86.89	5.64	72.97	98.01
Arkansas	322	431,490	84.70	5.74	65.32	95.53
Arizona	205	630,816	97.61	7.44	72.43	107.78
California	990	4,813,643	113.23	9.46	70.39	134.93
Colorado	176	573,985	98.77	8.29	63.48	117.15
Connecticut	160	453,468	113.57	5.40	92.11	121.05
District of Columbia	1	80,694	101.68	0.00	101.68	101.68
Delaware	16	96,384	101.83	4.58	90.85	106.18
Florida	67	1,862,185	95.09	6.26	77.04	107.17
Georgia	184	1,150,172	91.03	8.49	65.60	105.78
Hawaii	1	159,285	107.22	0.00	107.22	107.22
Iowa	429	483,176	87.54	6.70	67.80	98.49
Idaho	110	217,555	94.08	5.66	64.82	103.28
Illinois	942	1,795,477	106.32	14.83	67.47	126.04
Indiana	289	937,324	96.83	6.61	76.31	107.85
Kansas	302	436,494	86.20	9.31	51.98	100.63
Kentucky	176	630,091	87.94	5.47	69.15	98.99
Louisiana	65	774,724	82.73	3.39	71.58	87.98
Massachusetts	269	730,024	113.75	4.87	83.18	124.32
Maryland	22	669,620	103.20	5.80	84.92	109.89
Maine	215	208,599	102.00	6.08	84.36	112.97
Michigan	551	1,560,547	104.29	8.26	76.52	117.39
Minnesota	427	751,268	97.93	11.00	64.92	112.16
Missouri	538	805,029	93.52	10.51	63.91	109.08
Mississippi	149	491,684	82.15	4.60	70.05	92.51
Montana	499	148,411	90.22	5.96	67.06	107.32
North Carolina	133	1,084,489	91.84	4.83	75.69	101.36
North Dakota	261	117,531	85.44	8.29	59.97	104.95
Nebraska	720	269,106	86.76	9.39	51.84	104.57
New Hampshire	146	162,932	106.41	5.77	87.97	113.25
New Jersey	533	1,007,162	112.50	6.15	84.28	129.15
New Mexico	86	296,471	91.59	5.61	69.61	103.02
Nevada	17	201,316	96.30	4.53	81.86	111.11
New York	627	2,361,043	115.78	15.04	78.23	132.51
Ohio	610	1,766,733	100.60	6.76	79.39	114.47
Oklahoma	585	568,673	84.59	6.28	60.62	99.61
Oregon	291	483,345	99.64	7.60	62.70	131.34
Pennsylvania	499	1,629,157	105.34	8.70	83.29	122.25
Rhode Island	36	136,086	111.16	3.29	96.74	115.86
South Carolina	80	451,308	89.03	6.24	75.15	103.09
South Dakota	172	125,316	84.81	7.05	47.86	93.33
Tennessee	132	819,229	89.42	4.89	69.55	98.01
Texas	1,041	3,380,754	93.39	8.97	62.16	107.47
Utah	40	444,832	95.47	4.08	68.81	102.49
Virginia	129	984,702	96.19	8.77	70.82	110.71
Vermont	234	89,630	95.11	5.17	83.14	104.80
Washington	294	810,011	106.31	10.51	66.76	119.29
Wisconsin	424	796,114	97.19	7.33	75.31	110.33
West Virginia	54	318,577	85.65	3.17	76.66	93.08
Wyoming	49	97,976	87.18	4.54	69.68	106.65

SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

The five states with the lowest average teacher costs are, from lowest to highest, Mississippi (83.86), Louisiana (84.57), West Virginia (86.01), Oklahoma (86.60), and South Dakota (87.08). The standard errors of the index values for these lowest five states range from 0.6708 in Mississippi to 0.9341 in South Dakota. That is, the standard error is less than 1 percent in each case. Four of the five lowest cost states are located in the south (using the state classification scheme provided in the SASS dataset).

The five states with the largest within state variation in index values (based on the size of the standard deviation presented in the table) are, in order, Illinois (std. dev.=13.11), New York (std. dev.=12.70), Washington State (std. dev.=9.10), Missouri (std. dev.=8.99), and Minnesota (std. dev.=8.92). The states with the lowest within state variation in the index values (excluding Hawaii and the District of Columbia each of which have only one district) are Rhode Island (std. dev.=1.73), Vermont (std. dev.=2.67), West Virginia (std. dev.=3.01), Massachusetts (std. dev.=3.77), and Mississippi (std. dev.=3.79). In general, states with larger numbers of school districts tend to have larger variance. Among the five states which exhibited the highest within state variation, the average number of districts per state is 566. In contrast, the average number of districts in the five states with the lowest within state variation is 149.

Similar patterns of variation are observed for the state by state estimates of the district-level TCI. Not unexpectedly, the major difference is that the district-level TCI exhibits, on average, a greater level of variance ranging from a low of 47.86 to a high of 139.22. Furthermore, these low and high values are in the same states as for the regional-level TCI. Although the variance is larger, the standard errors of the district-level TCI are universally larger because the district-level variables do not show the same levels of statistical significance in the hedonic wage regression from which they are derived. In fact, only 16 of the standard errors of these index values are below 1 percent.

Teacher Cost Differences by Type of District

Tables 4.2A and 4.2B present the descriptive statistics for the regional- and district- level TCI, respectively, broken down by region of the United States, level of per pupil revenue in the district, population of the metropolitan area or county of location, distance from the central city, district enrollment, and type of city. As revealed in tables 4.1A and 4.1B, the regional-level index exhibits a somewhat narrower range of variation. All of the mean values of the cost factors used in calculating the TCI are weighted according to district enrollments. Thus, the mean values of the TCI represent the cost of services in the district serving the average student.

The reader should also recognize in viewing the results in tables 4.2A and 4.2B that these index values include the effects of the entire collection of cost factors, while controlling for certain job and teacher characteristics that affect teacher salaries. These results may or may not be consistent with the results suggested by the analysis of the individual parameter estimates which correspond to specific variables in which the effects of that particular variable are isolated from the rest of the cost factors. Thus, for example, the patterns of variation of teacher costs in relation to distance from the central city and district enrollment presented in tables 4.2A and 4.2B may differ from the analyses presented in chapter 3. The analysis of chapter 3 isolates the impact of district enrollment and distance from the central city from all other variables, while the results in tables reflect the overall effects of all cost factors for districts in these categories of district size or distance from the central cities.

Consistent with the analysis of tables 4.1A and 4.1B, tables 4.2A and 4.2B show that the average TCI tends to be lowest in the southern part of the United States and highest in the northeastern states. Using the regional-level TCI (table 4.2A), on average, a student in the south is enrolled in a district facing teacher costs about 8.1 percent below average, while students in the northeast are in districts facing costs of more than 11.5 percent above average, for similar teachers in similar schools. Districts in the west exhibit teacher costs about 4.4 percent above average, while districts in the midwestern United States are just about at the U.S. average.

Not surprisingly, districts with higher per pupil revenues, located in larger metropolitan areas, districts less than 20 miles from a central city, districts with greater enrollments, and more urbanized districts all tend to have higher teacher costs. While the average student attending a rural district would have access to the average teacher at a cost about 8.5 percent below average (i.e., an index value of 91.5), the student in a remotely located district would have access to that same teacher at about the average cost (i.e., at an index value of 99.86). Although competitive forces in the labor market might tend to drive salaries down in such districts, the results suggest that compensating differentials are necessary to attract teachers into remote regions located away from the amenities of urban life. Large central city districts and those located on the urban fringe of a large city revealed the highest average costs among types of cities at about 8.2 to 9.5 percent above average. Districts within 20 miles of the central city exhibit the highest costs, while districts between 40 and 80 miles of the central city exhibit the lowest costs. Districts more than 160 miles from the central city show costs just slightly below that of the districts within the 20 mile radius. Districts in the largest metropolitan areas (over one million in population) exhibit costs almost 10 percent above average, while districts in regions or counties with population less than 5,000 exhibit more than 16 percent below average teacher costs. Districts located in metropolitan areas of half a million to a million in population exhibit costs at the U.S. average.

Table 4.2A— The regional-level teacher cost index broken down by region, per pupil revenue, metropolitan population, distance from the nearest central city, district size, type of city, and percentage of children living in poverty

		Descriptive Statistics on Regional-Level TCI				
Category	Number of districts	Total enrollment	Mean	Standard deviation	Minimum	Maximum
Region						
Northeast	2,724	6,779,532	111.53	9.71	86.27	128.82
Midwest	5,683	9,844,377	100.02	10.39	53.49	119.69
South	3,287	14,519,980	91.91	7.84	68.32	111.61
West	2,800	8,972,138	104.36	9.70	71.10	137.37
Pupil revenue						
Less than 4,000	3,695	8,903,340	90.92	8.11	65.21	119.07
4,000-6,000	7,122	22,072,043	99.40	9.97	53.49	119.69
6,000-8,000	2,316	7,257,311	109.94	10.89	58.40	128.82
8,000-10,000	797	1,382,471	110.94	7.56	61.69	122.63
More than 10,000	564	500,862	113.51	7.35	65.21	137.37
Metro population						
Less than 5,000	686	166,555	83.66	9.18	53.49	118.64
5,000-20,000	3,341	2,521,938	84.92	6.29	65.87	137.37
20,000-50,000	2,999	4,170,191	88.05	5.80	72.46	122.63
50,000-100,000	1,519	3,201,822	92.06	5.92	77.81	112.27
100,000-500,000	2,458	8,348,309	95.19	7.24	73.34	119.24
500,000-1,000,000	1,188	5,578,574	100.16	7.82	85.28	118.26
More than 1,000,000	2,303	16,128,638	109.62	8.67	84.06	128.82
Distance from central city						
Less than 10	2,018	15,477,412	102.02	9.91	72.93	119.55
10-20	2,369	8,832,810	107.14	11.93	68.32	128.82
20-40	3,973	8,186,292	97.37	10.46	68.33	119.83
40-80	3,770	5,695,551	89.94	7.85	58.41	119.24
80-160	1,885	1,576,681	90.16	7.69	53.49	118.64
More than 160	479	347,281	99.86	11.20	65.21	137.37
District enrollment						
Less than 500	5,154	1,103,979	91.08	10.34	53.49	137.37
501-1,000	2,370	1,712,255	93.74	10.28	63.49	134.18
1,001-5,000	5,374	12,270,304	97.73	11.29	70.73	137.13
5,001-10,000	915	6,317,093	99.30	11.22	75.26	122.63
10,001-25,000	480	7,135,233	100.17	10.43	72.46	119.38
25,001-50,000	120	4,081,084	99.90	9.48	73.34	118.71
50,001-100,000	44	2,960,552	100.17	7.78	85.19	119.55
More than 100,000	21	4,523,514	111.40	12.18	91.21	128.82
Type of city						
Large central city	811	8,579,610	108.19	10.93	83.39	128.82
Mid-size central city	806	9,187,913	97.13	8.48	72.93	119.38
Urban fringe of large city	1,287	5,921,311	109.52	7.73	81.33	119.69
Urban fringe of mid-size city	810	2,861,090	99.38	9.98	70.58	118.26
Large town	418	1,154,387	92.46	8.54	58.40	118.58
Small town	4,158	8,812,909	93.26	9.93	70.05	137.13
Rural	6,174	3,596,914	91.53	8.68	53.49	137.37
% children in poverty						
Less than 10%	4,808	11,733,121	105.11	8.49	61.69	134.18
10%-20%	4,834	13,299,197	97.00	9.02	53.49	136.58
20%-40%	3,656	12,941,309	99.40	14.53	58.40	137.37
More than 40%	875	1,700,075	92.88	12.38	62.34	119.24

SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table 4.2B— The district-level teacher cost index broken down by region, per pupil revenue, metropolitan population, distance from the nearest central city, district size, type of city, and percentage of children living in poverty

		Descriptive Statistics on District-Level TCI				
Category	Number of districts	Total enrollment	Mean	Standard deviation	Minimum	Maximum
Region						
Northeast	2,719	6,778,101	111.40	11.54	78.23	132.51
Midwest	5,665	9,844,115	98.77	11.67	47.86	126.04
South	3,285	14,519,891	91.41	8.51	60.62	110.71
West	2,794	8,971,976	106.65	11.78	62.70	139.22
Pupil revenue						
Less than 4,000	3,693	8,903,178	90.21	8.98	56.76	128.04
4,000-6,000	7,109	22,071,743	99.55	11.51	47.86	134.93
6,000-8,000	2,305	7,256,355	110.55	12.94	51.84	132.51
8,000-10,000	794	1,381,996	110.36	8.92	54.54	129.15
More than 10,000	562	500,811	112.58	9.44	57.19	139.22
Metro population						
Less than 5,000	684	166,555	76.96	9.34	47.86	107.32
5,000-20,000	3,330	2,521,849	82.22	7.01	58.88	139.22
20,000-50,000	2,994	4,169,504	86.49	6.07	65.32	124.86
50,000-100,000	1,517	3,201,331	91.32	5.93	71.66	113.63
100,000-500,000	2,450	8,347,632	94.93	7.52	68.12	131.34
500,000-1,000,000	1,186	5,578,574	100.25	8.33	72.43	121.05
More than 1,000,000	2,302	16,128,638	110.77	10.16	82.53	134.93
Distance from central city						
Less than 10	2,018	15,477,412	102.51	10.70	64.36	129.15
10-20	2,361	8,832,395	108.08	13.72	60.76	132.51
20-40	3,970	8,186,030	96.79	11.76	60.62	134.93
40-80	3,763	5,694,335	88.49	8.74	51.84	117.74
80-160	1,875	1,576,630	88.63	8.99	47.86	112.08
More than 160	476	347,281	98.61	13.07	56.76	139.22
District enrollment						
Less than 500	5,124	1,102,560	81.49	9.47	47.86	128.19
501-1,000	2,369	1,711,730	88.80	9.94	60.01	131.34
1,001-5,000	5,374	12,270,304	96.86	11.55	69.60	139.22
5,001-10,000	915	6,317,093	101.19	12.22	77.28	134.93
10,001-25,000	480	7,135,233	101.68	11.55	76.67	132.35
25,001-50,000	120	4,081,084	99.97	10.63	74.37	126.19
50,001-100,000	44	2,960,552	98.03	8.57	82.53	121.06
More than 100,000	21	4,523,514	114.30	12.80	91.38	132.51
Type of city						
Large central city	811	8,579,610	109.20	12.71	79.39	132.51
Mid-size central city	806	9,187,913	97.58	9.37	64.36	125.63
Urban fringe of large city	1,287	5,921,311	110.66	8.97	75.85	134.93
Urban fringe of mid-size city	810	2,861,090	99.47	10.60	67.09	131.34
Large town	418	1,154,387	92.43	9.76	51.98	120.07
Small town	4,158	8,812,909	92.58	10.13	62.39	139.22
Rural	6,173	3,596,863	87.70	9.85	47.86	130.46
% children in poverty						
Less than 10%	4,795	11,732,655	104.86	9.68	55.05	129.98
10%-20%	4,828	13,297,979	96.89	10.54	47.86	131.34
20%-40%	3,651	12,941,049	99.80	16.46	51.98	139.22
More than 40%	873	1,700,075	92.04	12.34	53.73	118.25

SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

A Comparison of Alternative Models: The Case for the TCI

In this section, the TCI calculated in this report is compared to two alternative models for measurement of teacher cost differences: the Barro model which calculates average salaries controlling for education and experience and the cost-of-living (COL) model proposed by McMahon. Barro uses a teacher salary equation to develop an adjustment across states in the salaries of teachers by removing the variations in salaries associated with variations in educational preparation and experience—the two teacher characteristics commonly reflected in public school district salary scales for teachers. With the analysis file for teachers, Barro's nationwide regression equation is replicated, using a slightly modified version of his equation.[30] More detailed information on degree level and the level of certification, which Barro does not include in his analysis, are included in the present analysis. The parameter estimates and the standard errors for the Barro model are presented in Appendix B, table B.3 of this report. Using the same approach presented by Barro in his 1992 report, an index is calculated that reflects the variations in the average teacher salaries adjusted for differences in the level of educational preparation and experience—that is with the effect of education and experience removed. In effect, once adjusting for differences in educational preparation and experience, all of the remaining variation in pay is implicitly attributed to cost differences. Thus, all differences in teacher salaries attributable to differences in working conditions, teacher quality, local amenities or disamenities, and to random error are included in the cost index. The cost variation reflected in the Barro index represents a kind of upper-bound on teacher cost differences.[31]

McMahon and Chang (1991) and more recently McMahon (1994) have developed estimates of the variations in the cost of living across local jurisdictions. The COL developed in the 1991 paper is presented here for comparative purposes. McMahon's approach is to utilize 1981 data on the cost of living from the Bureau of Labor Statistics and more recent data for 1990 derived from the American Chamber of Commerce Research Association (ACCRA) to estimate an equation to be used to predict cost of living in areas for which the actual indices are not available. Based on his analysis, he is able to explain approximately 53 to 59 percent of the variance in cost of living with a fairly limited set of independent variables: the median value of housing, per capita personal income, the percentage change in population for the preceding decade, and a series of regional dummies.

Unfortunately, his predictive equation contains relatively weak results in terms of the statistical significance of his independent variables. Only the housing variable shows up in these equations with relatively stable and statistically significant coefficients. Per capita income is never significant at conventional levels (i.e., .05 or lower) and percentage change in population is statistically significant in only one of the three equations presented in his 1994 paper.

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[30] Barro also estimated separate equations for each state in his original analysis. However, there was little difference between the state-by-state model and the national model in the values of the estimated indices. For the sake of simplicity, only the national model is utilized in the present analysis for comparison purposes.

[31] The author gratefully acknowledges Dale Ballou and Michael Podgursky for helping clarify this point.

Moreover, one could question McMahon's use of median housing value as an independent variable. While one would expect that the variations in the price of land in a local jurisdiction is a major element in the determination of variations in the cost of living, the variable used by McMahon reflects not only the variations in the price of land but also the differences in the quality and characteristics of the housing stock within any given community. Differences in the attributes of the housing stock reflect differences in consumer choices resulting themselves from variations in land prices and consumer income.[32]

Tables 4.3 and 4.4 compare the alternative cost adjustments: the regional- and district-level TCI developed in this report, the Barro adjusted salary index, and the McMahon and Chang (1991) cost-of-living (COL) index. In comparing these various cost adjustments, it is important to reiterate just what each one represents. The regional-level TCI is intended to reflect the impact of variations in the factors that determine the cost of living as well as the amenities (e.g., climate, access to urban life, crime) associated with living and working in particular regions of a state. The district-level TCI encompasses the regional-level factors but adds a limited set of district specific characteristics. Barro's index simply removes the impact of variations in educational preparation and experience from average teacher salaries. It does not remove or control for any other attributes of the teachers or schools and districts that might be within local control. It makes the assumption that all other variations in teacher salaries except for those associated with education and experience reflect cost differences. And finally, the cost-of-living index is McMahon and Chang's (1991) estimated index of the cross-sectional variations in the costs of living in different regions of the states.

How well do the index values correlate with one another? Table 4.3 shows the standard Pearson correlation coefficients among the indices and the rank-order correlations. As one might expect, these indices of cost differences are highly correlated, and all of the correlations are significant at high levels (0.0001). The correlation between the two TCIs is 0.94, while the correlation between the TCIs and the Barro index is slightly greater than 0.70. The TCIs show a correlation of about 0.75 with the COL index. These are not surprising results given what these cost indices are supposed to represent. In fact, it would be surprising if these indices were not highly correlated. Factors affecting variations in the costs of living play a significant role in determining the variations in teacher cost differences and more specifically in the calculation of the TCI. However, the important contribution of the TCI is to recognize that regional- and district-level amenities also play a role in the ability of local districts to recruit and employ teachers. Both differences in the cost of living and regional amenities affect the cost of employing comparable teachers across local jurisdictions.

[32] The reader is referred to the discussion in chapter 1 on the role of socioeconomic status variables in the analysis of teacher salary variations.

Table 4.3— Correlation of the alternative teacher cost adjustments

	Pearson correlation				Spearman correlation			
	Regional-Level TCI	District-Level TCI	Barro Cost Index	McMahon/Chang Cost of Living Index	Regional-Level TCI	District-Level TCI	Barro Cost Index	McMahon/Chang Cost of Living Index
Regional-level teacher cost index	1.0000	0.9388	0.7152	0.7599	1.0000	0.9290	0.7033	0.7567
	0.0	0.0001	0.0001	0.0001	0.0	0.0001	0.0001	0.0001
District-level teacher cost index	0.9388	1.0000	0.7428	0.7497	0.9290	1.0000	0.7410	0.7576
	0.0001	0.0	0.0001	0.0001	0.0001	0.0	0.0001	0.0001
Barro’s teacher salary index	0.7152	0.7428	1.0000	0.7417	0.7033	0.7410	1.0000	0.7006
	0.0001	0.0001	0.0	0.0001	0.0001	0.0001	0.0	0.0001
McMahon cost-of-living index	0.7599	0.7497	0.7417	1.0000	0.7567	0.7576	0.7006	1.000
	0.0001	0.0001	0.0001	0.0	0.0001	0.0001	0.0001	0.0

SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

To see how these amenity factors differentiate the COL from the TCI, one must compare the values of the alternative cost indices, as is done in table 4.4. The last four rows show the rank ordering of the index values where a value of 1 corresponds to the lowest index value and a value of 116 is the highest index value. Each index is calculated for the various regions within each state. Some states are divided into metropolitan and nonmetropolitan areas, while other states are divided into specific large metropolitan areas (actually identified in the table), smaller metropolitan areas, and nonmetropolitan areas. The divisions of the state followed those utilized by McMahon and Chang (1991) in the presentation of their COL.

The COL ranges from a low of 82.3 in the nonmetropolitan areas of Oklahoma to a high of 143.64 in the San Francisco metropolitan area. The Barro index ranges from a low of 70.50 in the nonmetropolitan areas of Louisiana to a high of 144.17 in the nonmetropolitan areas of Alaska. The district-level TCI ranges from a low of 79.44 in the nonmetropolitan areas of Kansas to a high of 130.24 in New York City. The regional-level TCI ranges from a low of 80.43 in the nonmetropolitan areas of Louisiana to a high of 127.02 in New York City. Using the ratio of the highest to lowest cost district, the Barro index has the largest range of just over 2 to 1. The COL ratio is about 1.7 to 1, while the two TCIs have a ratio of about 1.6 to 1.

Table 4.4— A comparison of the regional- and district-level teacher cost index, the Barro teacher cost index, and the McMahon and Chang cost-of-living index

	Index values				Rank order of the index values			
State	Regional-level TCI	District-level TCI	Barro's Cost Index	McMahon/ Chang Cost of Living Index	Regional-level TCI	District-level TCI	Barro's Cost Index	McMahon/ Chang Cost of Living Index
ALASKA								
Nonmetropolitan	116.08	116.06	144.17	129.69	111	110	116	114
Metropolitan	110.42	110.71	135.84	120.71	100	101	114	106
ALABAMA								
Nonmetropolitan	84.01	82.79	79.99	89.77	6	10	20	25
Metropolitan	90.77	89.30	84.15	90.83	33	33	29	37
ARKANSAS								
Nonmetropolitan	85.07	81.52	71.51	88.07	9	6	3	14
Metropolitan	90.01	88.83	77.24	91.10	31	30	10	41
ARIZONA								
Nonmetropolitan	93.83	94.13	90.51	95.00	46	52	50	72
Metropolitan	98.27	98.90	100.34	95.69	65	69	74	75
CALIFORNIA								
Nonmetropolitan	95.29	95.16	121.28	93.89	56	57	106	60
Riverside-San Bernardino	106.00	108.61	121.88	104.40	91	97	108	93
Metropolitan	104.94	107.78	117.88	112.33	87	94	102	100
Los Angeles-Long Beach	117.46	123.04	129.78	122.22	113	114	113	108
San Jose	107.41	113.79	121.39	122.88	96	105	107	109
Anaheim-Santa Ana	118.38	123.26	127.40	123.83	114	115	112	110
San Francisco	108.43	113.91	125.66	143.64	98	106	111	116
COLORADO								
Nonmetropolitan	90.50	88.46	87.64	88.40	32	28	39	17
Metropolitan	95.57	96.20	96.90	94.25	59	62	66	69
Denver	105.53	104.93	104.97	96.58	89	90	81	78
CONNECTICUT								
Nonmetropolitan	106.06	102.79	115.97	93.96	92	81	100	65
Metropolitan	114.37	114.37	123.32	124.63	108	108	110	112
DISTRICT OF COLUMBIA								
Metropolitan	106.62	101.68	114.32	118.72	93	79	98	105
DELAWARE								
Nonmetropolitan	97.18	96.58	101.81	97.25	63	64	76	79
Metropolitan	105.66	105.66	105.66	106.75	90	92	88	95
FLORIDA								
Nonmetropolitan	87.12	87.29	91.40	91.95	20	25	53	47
Metropolitan	94.73	94.43	95.56	95.62	53	53	63	74
Miami-Hialeah	101.13	103.56	118.99	107.37	75	85	103	98

SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table 4.4— A comparison of the regional- and district-level teacher cost index, the Barro teacher cost index, and the McMahon and Chang cost-of-living index—Continued

	Index values				Rank order of the index values			
State	Regional-level TCI	District-level TCI	Barro's Cost Index	McMahon/Chang Cost of Living Index	Regional-level TCI	District-level TCI	Barro's Cost Index	McMahon/Chang Cost of Living Index
GEORGIA								
Nonmetropolitan	84.10	83.96	86.70	92.99	7	13	34	52
Metropolitan	96.20	95.22	93.64	93.60	60	58	57	56
HAWAII								
Metropolitan	92.49	107.22	97.68	125.34	39	93	68	113
Nonmetropolitan	92.49	107.22	97.68	125.34	39	93	68	113
IOWA								
Nonmetropolitan	87.36	83.47	79.01	90.77	22	12	17	34
Metropolitan	94.25	93.05	88.18	91.29	47	47	41	43
IDAHO								
Nonmetropolitan	93.50	93.54	82.46	87.74	45	49	23	12
Metropolitan	95.46	96.46	86.40	90.91	58	63	33	40
ILLINOIS								
Nonmetropolitan	88.35	85.43	79.48	92.09	25	18	18	48
Metropolitan	99.76	98.88	94.14	99.86	71	68	60	87
Chicago	118.85	119.72	106.08	113.61	115	113	90	101
INDIANA								
Nonmetropolitan	92.02	90.75	91.06	90.30	37	38	52	30
Metropolitan	100.16	99.40	97.08	91.54	73	70	67	44
KANSAS								
Nonmetropolitan	82.00	79.44	82.87	84.95	2	1	25	4
Metropolitan	93.22	92.59	90.18	93.51	42	45	47	55
KENTUCKY								
Nonmetropolitan	85.53	84.51	82.28	86.27	13	16	22	6
Metropolitan	94.52	92.86	88.43	90.79	51	46	42	35
LOUISIANA								
Nonmetropolitan	80.43	79.45	70.50	88.40	1	2	1	17
Metropolitan	86.46	84.23	76.97	93.46	17	14	9	54
MASSACHUSETTS								
Nonmetropolitan	112.46	109.50	100.12	93.94	105	99	73	62
Metropolitan	114.12	113.92	102.23	113.75	107	107	77	102
MARYLAND								
Nonmetropolitan	91.20	90.58	105.31	96.30	36	35	86	77
Metropolitan	104.99	104.34	115.21	102.45	88	87	99	92

SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table 4.4— A comparison of the regional- and district-level teacher cost index, the Barro teacher cost index, and the McMahon and Chang cost-of-living index—Continued

	Index values				Rank order of the index values			
State	Regional-level TCI	District-level TCI	Barro's Cost Index	McMahon/ Chang Cost of Living Index	Regional-level TCI	District-level TCI	Barro's Cost Index	McMahon/ Chang Cost of Living Index
MAINE								
Nonmetropolitan	102.87	100.39	89.22	93.94	81	74	44	62
Metropolitan	108.27	108.50	93.36	98.38	97	96	55	83
MICHIGAN								
Nonmetropolitan	94.50	92.42	98.27	97.91	50	44	69	80
Metropolitan	102.10	101.10	105.04	101.15	77	76	84	91
Detroit	112.16	111.45	120.22	111.28	104	102	105	99
MINNESOTA								
Nonmetropolitan	88.76	85.60	95.88	90.09	26	20	64	28
Metropolitan	104.43	104.66	108.24	94.63	86	89	92	71
MISSOURI								
Nonmetropolitan	85.15	82.42	72.11	84.14	11	9	4	2
Metropolitan	100.06	99.95	90.97	89.35	72	72	51	23
MISSISSIPPI								
Nonmetropolitan	82.27	80.25	74.37	88.26	3	5	6	15
Metropolitan	87.72	86.79	79.56	90.83	24	23	19	37
MONTANA								
Nonmetropolitan	95.25	90.63	82.59	88.79	55	36	24	20
Metropolitan	89.57	88.86	85.62	90.44	30	31	31	32
NORTH CAROLINA								
Nonmetropolitan	89.13	88.46	86.26	91.57	29	29	32	45
Metropolitan	96.36	94.93	87.30	93.83	61	55	37	59
NORTH DAKOTA								
Nonmetropolitan	87.14	81.71	74.10	90.09	21	7	5	28
Metropolitan	92.55	91.53	78.67	93.27	40	39	15	53
NEBRASKA								
Nonmetropolitan	85.12	80.13	74.85	84.50	10	4	7	3
Metropolitan	95.39	94.46	90.18	87.46	57	54	48	9
NEW HAMPSHIRE								
Nonmetropolitan	107.39	104.38	95.02	93.96	95	88	61	65
Metropolitan	110.62	109.29	105.45	115.69	101	98	87	104
NEW JERSEY								
Newark	113.02	112.50	117.27	115.46	106	104	101	103
Metropolitan	113.02	112.50	117.27	115.46	106	104	101	103
Nonmetropolitan	113.02	112.50	117.27	115.46	106	104	101	103

SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table 4.4— A comparison of the regional- and district-level teacher cost index, the Barro teacher cost index, and the McMahon and Chang cost-of-living index—Continued

	Index values				Rank order of the index values			
State	Regional-level TCI	District-level TCI	Barro's Cost Index	McMahon/ Chang Cost of Living Index	Regional-level TCI	District-level TCI	Barro's Cost Index	McMahon/ Chang Cost of Living Index
NEW MEXICO								
Nonmetropolitan	87.39	89.03	83.59	92.76	23	32	28	50
Metropolitan	94.79	95.45	81.60	95.40	54	59	21	73
NEVADA								
Nonmetropolitan	97.40	98.10	109.90	98.76	64	67	93	85
Metropolitan	94.26	95.85	105.07	101.10	48	60	85	90
NEW YORK								
Nonmetropolitan	98.45	96.18	100.89	94.12	67	61	75	68
Metropolitan	103.68	102.86	112.37	100.10	85	84	96	88
New York	127.02	130.24	123.07	124.38	116	116	109	111
Nassau-Suffolk	115.63	115.92	140.92	130.29	110	109	115	115
OHIO								
Nonmetropolitan	93.46	91.81	89.30	90.88	44	40	45	38
Metropolitan	102.87	101.58	99.02	92.98	80	78	71	51
Cleveland	111.66	109.75	106.40	105.89	103	100	91	94
OKLAHOMA								
Nonmetropolitan	83.10	79.68	75.82	82.30	4	3	8	1
Metropolitan	88.87	87.77	78.41	88.69	27	27	14	18
OREGON								
Nonmetropolitan	94.69	93.38	90.40	89.77	52	48	49	25
Metropolitan	103.34	102.83	99.51	93.65	83	83	72	57
PENNSYLVANIA								
Nonmetropolitan	96.44	95.16	95.06	94.12	62	56	62	68
Metropolitan	102.66	102.06	98.71	98.95	79	80	70	86
Pittsburgh	106.66	105.24	112.21	100.37	94	91	95	89
Philadelphia	116.92	117.12	119.93	122.22	112	112	104	108
RHODE ISLAND								
Nonmetropolitan	110.22	108.46	112.38	93.96	99	95	97	65
Metropolitan	110.82	111.47	111.81	98.34	102	103	94	82
SOUTH CAROLINA								
Nonmetropolitan	85.77	84.67	87.27	87.69	15	17	36	11
Metropolitan	94.39	93.55	89.20	91.19	49	50	43	42

SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table 4.4— A comparison of the regional- and district-level teacher cost index, the Barro teacher cost index, and the McMahon and Chang cost-of-living index—Continued

State	Index values				Rank order of the index values			
	Regional-level TCI	District-level TCI	Barro's Cost Index	McMahon/ Chang Cost of Living Index	Regional-level TCI	District-level TCI	Barro's Cost Index	McMahon/ Chang Cost of Living Index
SOUTH DAKOTA								
Nonmetropolitan	86.05	83.28	70.87	89.82	16	11	2	26
Metropolitan	92.11	92.26	77.45	91.67	38	43	12	46
TENNESSEE								
Nonmetropolitan	85.04	84.50	77.59	87.91	8	15	13	13
Metropolitan	93.31	92.25	86.72	90.15	43	42	35	29
TEXAS								
Nonmetropolitan	83.39	82.07	83.23	88.97	5	8	26	22
Metropolitan	90.83	92.03	87.49	90.71	35	41	38	33
Houston	99.49	101.15	92.66	93.75	70	77	54	58
Dallas	102.92	103.68	87.81	98.57	82	86	40	84
UTAH								
Nonmetropolitan	90.82	90.72	83.38	85.89	34	37	27	5
Metropolitan	98.28	96.87	84.73	87.12	66	65	30	8
VIRGINIA								
Nonmetropolitan	87.07	87.21	89.79	96.30	19	24	46	77
Metropolitan	99.45	99.70	104.99	107.15	69	71	82	97
VERMONT								
Nonmetropolitan	100.93	93.85	93.47	93.96	74	51	56	65
Metropolitan	103.46	100.32	104.52	98.34	84	73	80	82
WASHINGTON								
Nonmetropolitan	98.96	97.93	103.68	87.69	68	66	79	11
Metropolitan	102.40	102.83	106.02	92.16	78	82	89	49
Seattle	115.21	117.01	105.03	107.08	109	111	83	96
WISCONSIN								
Nonmetropolitan	92.86	90.26	93.91	90.91	41	34	58	40
Metropolitan	101.93	100.92	103.52	94.41	76	75	78	70
WEST VIRGINIA								
Nonmetropolitan	85.74	85.44	77.37	87.10	14	19	11	7
Metropolitan	86.52	86.06	79.01	88.80	18	22	16	21
WYOMING								
Nonmetropolitan	88.97	87.70	93.93	88.79	28	26	59	20
Metropolitan	85.25	85.76	95.94	90.44	12	21	65	32

SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Using the COL, the highest cost-of-living areas of the United States are, in order, the San Francisco metropolitan area (143.64), Nassau-Suffolk in New York (130.29), the nonmetropolitan areas of Alaska (129.69), Hawaii (125.34), and the metropolitan areas of Connecticut (124.63).[33]

How do these top five cost-of-living regions line up with the regional-level TCI? The highest COL of 151.84 in the San Francisco metropolitan area compares to a regional-level TCI of 108.43. Similarly, the cost-of-living index for the nearby San Jose metropolitan area is 122.88 compared to a TCI of 107.41. San Francisco and San Jose combine to form the greater San Francisco Bay area, which is commonly regarded as an attractive region of the country in which to live because of climate and a variety of other factors. San Francisco and San Jose rank 98th and 96th (out of 116) on the TCI, while they rank 116 (the highest) and 109 on the COL. The COL values for the highest cost-of-living regions of the country exceed the average values of the TCIs for these regions by more than 28 percentage points. These represent significant differences in the perception of what constitutes high costs. These results suggest that even with the very high cost of living, teachers are willing to trade off compensation for the amenities of living in the San Francisco-San Jose metropolitan areas.

Hawaii provides another example of a portion of the country with a relatively high cost of living (125.34) and a relatively low TCI (the regional-level TCI averages 92.49 and the district-level TCI is 107.22).[34] The regions of the state of Florida show a similar pattern with higher costs of living relative to the alternative TCIs. In fact, none of the top five COL locations in the country match up with the top five locations on the regional-level TCI.

The lowest COL regions are, in order, the nonmetropolitan areas of Oklahoma (82.30), the nonmetropolitan areas of Missouri (84.14), the nonmetropolitan areas of Nebraska (84.50), the nonmetropolitan areas of Kansas (84.95), and the nonmetropolitan areas of Utah (85.89). Among these lowest COL regions, the regional-level TCI ranges from about 2.95 percent below the COL to as much as 4.93 percent above the COL. The lowest regional-level TCI regions are, in order, the nonmetropolitan areas of Louisiana (80.43), the nonmetropolitan areas of Kansas (82.00), the nonmetropolitan areas of Mississippi (82.27), the nonmetropolitan areas of Oklahoma (83.10), and the nonmetropolitan areas of Texas (83.39). Two of the regions in the lowest five COL group are also in the lowest five TCI group: Kansas and Oklahoma.

Table 4.5 provides an example of how the TCI might be used to report information on average full-time teacher salaries. The actual salary level for each state is reported in the first column. The statewide average salary level based on teacher salaries adjusted by the regional-

[33] Hawaii has only a single district state-wide. Because of this, it is not possible with current data to estimate indices separately for different regions of the state of Hawaii.

[34] Hawaii is a one-district state. To reiterate what is implied by the equations 4.1 and 4.2, the difference between the regional- and district-level TCIs in Hawaii is the inclusion of the district level of variables (D_j) in the calculation. A similar explanation holds for Washington, D.C. as well. The regional-level TCI in each case includes only the regional-level variables.

level TCI is presented in the second column. The statewide average teacher salary level adjusted by the COL index is shown in the third column. The last three columns report the state rankings of the actual and cost-adjusted statewide average salary levels.

It is interesting to compare actual versus TCI- and COL-adjusted average salaries. The COL adjustment equalizes the purchasing power of teacher salary dollars across the available goods and services purchased in local markets. The TCI accounts for both the differences in the purchasing power of teacher salary dollars as well as the monetary value that teachers place on local amenities. It accounts for what teachers are willing to sacrifice in terms of purchasing power to live and work in "more attractive" communities (e.g., with lower crime, better climates, and greater access to employment or consumption opportunities). Given the actual average salary levels in each state, these adjusted salary figures reflect the estimated value of real teacher services.

Based on these 1990–91 figures, the average teacher in Alaska earned \$42,687, compared to \$38,610 in California; however, the difference in the value of teacher services was smaller. Alaska received teacher services worth \$36,618 in the national market, while California received about \$35,372 in teacher services. South Dakota paid an actual average teacher salary of \$21,530, while it received \$25,165 in teacher services.

Table 4.5— A comparison of actual and cost adjusted average teacher salary and rankings, by state

	Average Full Time Salary			Rank order by state of Average Full Time Salary		
State	Actual	Adjust by the Regional-Level TCI	Adjust by the COL	Actual	Adjust by the Regional-Level TCI	Adjust by the COL
Alaska	$42,687	$36,618	$33,512	50	50	38
Alabama	$26,330	$29,913	$29,085	16	20	13
Arkansas	$22,256	$25,713	$24,937	2	2	3
Arizona	$30,510	$31,945	$32,014	26	31	31
California	$38,610	$35,327	$33,580	47	46	39
Colorado	$31,234	$31,929	$33,323	31	30	35
Connecticut	$44,260	$39,128	$36,606	51	51	50
District of Columbia	$37,860	$35,508	$31,890	46	47	30
Delaware	$34,190	$33,807	$33,640	40	41	40
Florida	$30,557	$32,154	$31,419	27	32	26
Georgia	$28,470	$31,569	$30,500	22	27	22
Hawaii	$30,949	$33,464	$24,692	30	38	2
Iowa	$26,046	$29,116	$28,632	12	14	11
Idaho	$25,229	$27,034	$28,643	9	5	12
Illinois	$31,873	$30,672	$30,828	33	22	24
Indiana	$32,926	$33,550	$36,037	37	40	48
Kansas	$27,228	$31,872	$30,797	18	29	23
Kentucky	$29,076	$32,726	$33,024	24	35	34
Louisiana	$23,406	$27,648	$25,344	4	7	5
Massachusetts	$35,450	$31,231	$31,506	42	25	27
Maryland	$36,986	$36,303	$36,296	44	49	49
Maine	$28,147	$27,167	$29,814	20	6	20
Michigan	$37,482	$36,005	$35,739	45	48	46
Minnesota	$33,157	$34,100	$35,809	38	43	47
Missouri	$26,048	$27,864	$29,801	13	9	19
Mississippi	$24,451	$29,298	$27,499	6	15	6
Montana	$26,019	$27,945	$29,157	11	10	15
North Carolina	$27,337	$29,786	$29,517	19	19	17
North Dakota	$22,828	$25,815	$25,100	3	3	4
Nebraska	$24,817	$27,953	$29,085	8	11	14
New Hampshire	$32,034	$29,389	$30,939	34	17	25
New Jersey	$39,195	$35,062	$34,334	48	45	42
New Mexico	$26,051	$29,328	$27,854	14	16	7
Nevada	$32,678	$34,072	$32,610	36	42	33
New York	$39,283	$34,822	$35,718	49	44	45
Ohio	$31,417	$30,944	$33,494	32	23	36
Oklahoma	$23,675	$27,792	$27,895	5	8	8
Oregon	$30,813	$31,045	$33,500	28	24	37
Pennsylvania	$35,087	$33,526	$34,025	41	39	41
Rhode Island	$36,223	$32,714	$36,956	43	34	51
South Carolina	$28,250	$31,433	$31,510	21	26	28
South Dakota	$21,530	$25,165	$23,924	1	1	1
Tennessee	$27,049	$30,046	$30,296	17	21	21
Texas	$26,180	$28,934	$28,620	15	13	10
Utah	$25,546	$26,564	$29,420	10	4	16
Virginia	$30,869	$32,710	$29,782	29	33	18
Vermont	$29,963	$29,748	$31,810	25	18	29
Washington	$33,285	$31,825	$34,881	39	28	44
Wisconsin	$32,173	$32,918	$34,636	35	36	43
West Virginia	$24,495	$28,655	$27,963	7	12	9
Wyoming	$28,983	$33,131	$32,494	23	37	32

SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Summary and Implications

This chapter provides comparisons of the TCI derived from the hedonic wage model with the variations across states in McMahon and Chang's (1991) COL index, average teacher salaries, and an updated version of Barro's (1992) average teacher salary index adjusted for variations in education and experience.

McMahon (1994) argues that the COL index is preferable to a cost-of-education index because the COL index is calculated using variables outside the control of school decisionmakers. He argues that because school decisionmakers have control over salaries, they would tend to make adjustments in the salary levels if they found that federal authorities were using an index based on actual salaries of teachers. In fact, the TCI calculated in this paper is based on a statistical analysis of salary variations in relation to a collection of exogenously determined variables. These variables reflect locational factors that are beyond local district control. The impact of any given district attempting to adjust salaries in order to affect the index would be negligible and would certainly not bring forth the additional revenue necessary to cover the costs of increasing salaries in the first place. Moreover, in the long run, such salary adjustments would attract a more highly qualified pool of applicants. This would be reflected in the data and would diminish any impact on costs. Even if relatively large numbers of districts attempted to manipulate salary levels in this fashion, the revenue resulting from such a move would probably not be sufficient to compensate for the additional costs of doing business.

While the COL of McMahon and Chang, the Barro teacher cost index, and the regional- and district-level TCIs calculated in this paper show high correlations, there are significant differences in the values of these indices and what they represent. The COL accounts only for variations in the cost of living which, while an important part of teacher cost differences, does not capture all of the relevant factors. The Barro index, while controlling for education and experience, fails to control for variations in other teacher and school attributes that are within local control.

In contrast, the TCIs presented in this paper represent an attempt to account for all of the factors that affect the ability of local school systems to recruit and employ teachers. It accounts for the factors that underlie differences in the cost of living, and it accounts for differences in regional amenities that affect their attractiveness as places to live and work. It was demonstrated that despite the high correlations, there were some important differences in the ordering of regions of the country according to these indices as well as the magnitudes themselves. Using an inappropriate index for adjusting salary or expenditure data can lead to significantly different conclusions about the levels of educational services being provided in different regions of the country.

One of the serious problems confronted in the types of analyses of teacher salaries presented in this paper is the lack of reliable measures of teacher quality.[35] Without such measures of teacher quality included in the analysis, there is likely to be bias in the estimated compensating differentials associated with certain working conditions or local amenities. Suppose, for example, that unmeasured variation in teacher quality is present and it is negatively related to preferred working conditions or locational amenities—that is, schools located in attractive communities or jobs with preferable characteristics will tend to employ above-average quality teachers, while schools in less attractive locations or job assignments will tend to employ poorer quality teachers. Thus, measures of community or job attractiveness are positively correlated with an omitted variable, which itself has a positive relationship with the dependent variable (salary). The result in this case would be coefficients on valued working conditions or amenities that are biased upward, while coefficients on disamenities are biased downward. Since coefficients on amenities are expected to be negative (i.e., teachers give up wages to work in preferred locations or jobs) and vice versa for disamenities, both sets of coefficients will be biased toward zero. That is, the compensating differentials will be systematically understated.

Future work on the analysis of teacher compensation could be improved along two dimensions. First, following the logic of the argument presented immediately above, it is important to add to the list of dimensions that might provide some information about teacher quality. That is, what other characteristics of teachers are valued by public and private school decisionmakers? In the 1987–88 SASS survey, the undergraduate colleges or universities attended by teachers was reported. At least one previous study by Ballou and Podgursky (1993) used these data to associate teacher salaries with the selectivity of these undergraduate institutions of higher education. Some differences in the way public and private schools remunerated these attributes were revealed. At the very least, it would be useful for future versions of SASS to include coded data on the undergraduate institution attended by each teacher. This would permit analysts to match information on college selectivity, average Scholastic Aptitude Test (SAT) scores of entering freshmen, or other measures of college quality as a proxy for the intellectual endowments of teachers. Preferred measures of teacher quality might be obtained by requesting direct measures of an individual teacher's capabilities, such as the scores on the verbal or quantitative components of the SAT (e.g., 400s, 500s, 600s, 700s) or the National Teacher Exam (NTE). However, it is recognized that many individuals may not remember such scores or may selectively report them, which would make such data problematic.

A second area in which data could be improved is with respect to benefits received by teachers. The current SASS does not report data that would permit one to determine total compensation. Benefit packages in the public sector often include retirement, medical, dental, life, and vision insurance. While current data report whether some of these items are available to teachers in the public or private sector, they do not report the value of the district or private school contributions to these benefit packages. These amounts could easily add up to a total of

[35] The discussion that follows draws heavily from comments made by Dale Ballou and Michael Podgursky in a review of an earlier draft of this report. The author much appreciates their significant analysis of these issues.

30 to 40 percent on top of salaries. Of course, if they are highly correlated with salaries, the current analysis of salaries probably captures the same patterns of variation. If, on the other hand, there is considerable variability in the value of benefits contributed by the schools or districts in different states, the analysis of salaries will not represent the variations in the patterns of compensation very well.

Future research in this area should expand the analysis of teacher salaries to other resources. The SASS data would support similar analyses being carried out for principals. These data could be used to estimate cost adjustments that could be used for all school administrative personnel. Further research should also be done to estimate the costs of noncertified personnel. While it is expected that patterns of school administrator costs will be similar to those for teachers, noncertified personnel tend to operate in more localized labor markets and have been found in the past to have somewhat differing patterns of cost variation than certified personnel (see Chambers 1978). Finally, in order to develop a comprehensive cost of education index, it will be necessary to obtain some data on the variations in the costs of nonpersonnel resources that account for the approximately 15 percent of the budget not going into personnel.

The existing dataset developed for this analysis did not have sufficient information on the nature of bargaining relationships between districts and teachers. In order to assess the impact of collective bargaining arrangements on teacher salaries, it would be interesting to explore the possibilities for merging any data that might be obtained on the types of bargaining, the state laws and regulations, and the extensiveness of bargaining in different regions of the country to explore the overall impact on salary levels.

Another question of interest is how these cost indices change over time. Are these estimates stable? Have there been any major shifts in the patterns of cross-sectional differences in teacher costs? Given the SASS data for 1987–88, the existing 1990–91 dataset, and the soon to be available 1993–94 dataset, it would certainly be of interest to estimate the same wage relationship for these 3 years and compare the TCIs coming out of each. This same analysis could also yield some interesting results in determining the changes in teacher costs over time for the purpose of estimating an inflationary index. This would not only provide national estimates, but also estimates of the differential rates of inflation in teacher costs in different parts of the country.

Estimation of the teacher cost index in this paper represents a major breakthrough for researchers interested in examining the patterns of educational cost differences, and in assessing the equity with which school resources are distributed across states and local jurisdictions in this country. The hope is that the desire for this information will stimulate the additional research necessary to complete the work of developing a comprehensive cost of education in the near future.

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Appendix A

Technical Notes

Sample Selection[1]

For the Schools and Staffing Survey (SASS), schools were selected first. Each selected school received a school questionnaire and an administrator questionnaire. Next, a sample of teachers was selected within each school, and each received a teacher questionnaire. The sample for the SASS conducted during the 1990–1991 school year included 12,856 schools and administrators, 62,217 teachers, and 5,515 local education agencies.

SASS was designed to provide national estimates for public and private schools; state estimates for public schools; state elementary, state secondary, and national combined estimates for public schools; association and grade-level estimates for private schools; estimates of change from 1988 to 1991 in school-level characteristics; and national estimates for schools with greater than 25 percent Indian enrollment. The teacher survey was designed to support comparisons between new and experienced teachers. Comparisons between bilingual and nonbilingual teachers are possible at the national level.

Selection of Schools

The SASS public school sample of 9,586 schools was selected primarily from the 1988–89 school year Common Core of Data (CCD) file. The CCD is based on survey data collected annually by NCES from all state education agencies and is believed to be the most complete list of public schools available. The frame includes regular public schools, Department of Defense operated military base schools, and nonregular schools such as special education, vocational, and alternative schools.

Selection of LEAs

All LEAs that had at least one school selected for the school sample were included in the LEA sample for the TDS Survey. Each Bureau of Indian Affairs and Department of Defense school was defined to be an LEA. Some LEAs did not have schools, but hired teachers who taught in schools in other LEAs. To ensure representation of these teachers, a sample of 135 LEAs without eligible schools was selected. Only 14 of the 135 were actually in scope (that is, were an operating public school agency that reported hiring teachers). All LEAs in Delaware, Nevada, and West Virginia were included to reduce high standard errors in these states. The total LEA sample was 5,515.

Selection of Teachers

All 56,051 public school teachers in the teacher samples were selected from the sampled public schools. The average number of teachers selected per school was 3.49, 6.98, and 5.23 teachers for public elementary, secondary, and combined schools, respectively.

[1] For a detailed description of the sample design of the 1990–91 SASS, see Kaufman and Huang, 1993.

Data Collection

The data were collected for NCES by the United States Bureau of the Census. Questionnaires were mailed to school districts and administrators in December 1990 and to schools and teachers in January and February 1991.[2] Six weeks later, a second questionnaire was sent to each nonrespondent. A telephone follow-up of nonrespondents was conducted between March and June.

Weighting

Weights of the sample units were developed to produce national and state estimates for public schools, teachers, administrators, and LEAs. The private-sector data were weighted to produce national estimates and affiliation group estimates. The basic weights were the inverse of the probability of selection, and were adjusted for nonresponse and also to adjust the sample totals (based on responding, nonresponding, and out of scope cases) to the frame totals in order to reduce sampling variability.

Response Rates and Imputation

The final weighted questionnaire response rates were as follows:

	Public	Private
SASS:		
Teacher Demand and Shortage	93.5	----
Administrator	96.7	90.0
School	95.3	83.9
Teacher*	90.3	84.3

---- not applicable

*The response rates for public school teachers do not include the 5 percent of the public schools that did not provide teacher lists, and the response rates for private school teachers do not include the 11 percent of the private schools that did not provide teacher lists. The effective response rate for public schools was 85.8 percent and for private schools, 75.9 percent.

Values were imputed for items with missing data by: (1) using data from other items on the questionnaire or a related component of the SASS (a school record to impute district data, for example); (2) extracting data from the sample file, such as the CCD or PSS; or (3) extracting data from a respondent with similar characteristics.[3]

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[2] Copies of the questionnaires may be obtained by writing to the Schools and Staffing Survey, National Center for Education Statistics, Elementary and Secondary Education Division, 555 New Jersey Ave., N.W., Washington, DC 20208–5651.

[3] For a detailed description of the imputation procedures in the 1990–91 SASS, see Kaufman and Huang, 1993, pp. 60–87.

Standard Errors

The estimates in these tables are based on samples and, hence, are subject to sampling variability. Standard errors are used to indicate the accuracy of each estimate. If all possible samples of the same size were surveyed under the same conditions, an interval of 1.96 standard error units below to 1.96 standard error units above a particular statistic would include the universe value in approximately 95 percent of the cases. Note, however, that the standard errors do not take into account the effect of biases due to item nonresponse, measurement error, data processing error, or other possible systematic error.

Standard errors were estimated using a balanced repeated replications procedure. Because this procedure incorporates the design features of the complex sample survey, the standard errors are generally higher than those calculated under the assumptions of simple random sampling. Standard errors for selected tables are presented in the Appendix.

Technical Notes on the Development of the Analysis File for the Teacher Salary Regressions

The Nonfiscal Surveys of the Common Core of Data

These data for the universe of local school districts were used to fill in missing school and district level information for those teachers in the SASS sample employed in schools or districts that did not complete the SASS school and district questionnaires. Only data on district and school level enrollment and race/ethnic composition were utilized for this purpose.

Census Data

County level Census files included many of the regional variables utilized in the analysis of regional teacher cost differences. Variables of interest derived from this file are listed below:

Average value of farm land and buildings per acre.
Number of violent crimes known to police (1988)
Number of serious crimes known to police (1988)
Number of robberies known to police (1988)
Number of aggregated assaults known to police (1988)
Number of property crimes known to police (1988)
Number of burglaries known to police (1988)
Number of larceny-thefts known to police (1988)
Number of motor vehicle theft known to police (1988)
Civilian labor force unemployment rate (BLS) (1989)
Land area in square miles (1990)
Resident population 1980
FBI Uniform Crime Statistics by county,
Number of physicians per 100,000 population, Number of banks per 100,000 population,

Data were also obtained from Census files on the population of metropolitan areas by aggregating county level data based on the codes for metropolitan areas.

Geographical Location

This dataset was requested from the following agency:

Geographic Names Information System (GNIS)
U.S. Geology Survey
523 National Center
Reston, VA 22092

These data were used to attach latitude and longitude data to each central city, cities in the CCD-district file and the CCD-school file. The *Geographic Names Information System* CD-ROM contains the latitude and longitude for most United States cities, towns, and geographic locations. The disc also contains the state and county FIPS codes to facilitate matching to the SASS. These data were used to determine distances between two cities or points for matching certain other data elements (e.g., climate and central city locations) described below.

Climate Data

Climatic data were requested from the National Climatic Data Center located in Asheville, North Carolina at the following address:

National Climatic Data Center
Federal Building
37 Battery Park Ave.
Asheville, NC 28801-2696

A series of climatic indicators for almost 300 reporting stations around the country were utilized for this analysis of teacher costs. Using the latitude and longitude of each district and each climatic reporting station, one can calculate the distance to each of the approximately 300 reporting stations and match each district to the nearest reporting station. This was done using the formula for calculating distances on a sphere. The formula for calculating these distances is presented later in this technical Appendix.

The World Weather Disc: Climate Data for the Planet Earth is a CD-ROM that contains climatic indicators from the National Climatic Data Center and the National Center for Atmospheric Research. It is produced by Weather Disc Associates, Inc. It contains data from 1951 to 1980. The disc also contains the latitude and longitude of each weather reporting station.

Calculating Distances on a Sphere:

For two of the variables in the analysis of teacher salaries, it was necessary to calculate distances between locations within the United States. First, in order to assign the appropriate climatic data, it was necessary to identify the closest weather station to each district. Second, in order to capture some of the regional variations related to urban land values and also to assess the remoteness of districts from urban centers, it was necessary to calculate the distances of district offices from various central cities.

For each of these calculations, data on the latitude and longitude of the district offices were derived from the *Geographical Names Information System* by matching the city names to the cities in which district offices were located. The latitude and longitude of the weather stations is reported directly on the climatic database. For each district, the distances were calculated from each weather station and the closest weather station was selected.

A list of central cities was obtained from the Census and utilized to calculate the distances from each district to each and every central city. The closest three cities were selected.

In each case, distances were calculated using the formula for calculating distances on a sphere given data on the latitude and longitude of each location. The procedure is described in the steps specified below.

1. Convert degrees, minutes and seconds to decimal degrees.

```
Separate LATITUDE and LONGITUDE in three components:
DEGREES
MINUTES
SECONDS

Calculate decimal degrees as follows:

MINUTES = SUM(MINUTES,SECONDS/60);
DEG_DEC = SUM(DEGREES,MINUTES/60);
```

2. Convert degrees to radians.

```
DEG_RAD = DEG_DEC*(3.14159265/180);
```

3. Distance formula.

```
* CITY 1 @ LATITUDE=X1, LONGITUDE=Y1
  CITY 2 @ LATITUDE=X2, LONGITUDE=Y2
;

R=3960; *RADIUS OF THE EARTH;
LABEL R = 'RADIUS OF THE EARTH';

*DISTANCE BETWEEN TWO POINTS;
DISTANCE=R*ARCOS(SIN(X1)*SIN(X2)+COS(X1)*COS(X2)*COS(ABS(Y1-Y2)));
```

Factor Analysis of Teacher Attitudes and Perceptions

More than 50 items on the SASS teacher questionnaire were designed to gather data on teacher attitudes and perceptions about their work environment. To utilize these variables in the analysis of salaries, it was decided to conduct a factor analysis of these many variables to try and identify common patterns of variation as a way of consolidating these variables into a smaller number of factors. Seven index variables were constructed based on the results of the factor analysis. Each index variable was calculated on 10-point scale and were designed to represent the values of the component variables. Each index variable is listed below along with the component variables derived from the SASS teacher questionnaire. The name used in the AIR teacher analysis file is listed along with the scaling calculation and the original variable name as listed in the SASS teacher questionnaire. The SASS variable names begin with the prefix (tsc). The variable label created for the AIR teacher cost analysis file is also presented to add clarity.

Indices used for the analysis of the impact of teacher attitudes and perceptions on teacher salaries.

I_VIOLNC (INDEX-VIOLENT STUDENT BEHAVIOR) is mean of following variables.

PRB_PHYC = 2.5 * tsc258 PROBLEM: PHYSICAL CONFLICTS AMONG STDNTS
PRB_VNDL = 2.5 * tsc260 PROBLEM: VANDALISM OF SCHOOL PROPERTY
PRB_GUNS = 2.5 * tsc264 PROBLEM: STUDENT POSSESSION OF WEAPONS
PRB_PABT = 2.5 * tsc265 PROBLEM: PHYSICAL ABUSE OF TEACHERS
PRB_VABT = 2.5 * tsc266 PROBLEM: VERBAL ABUSE OF TEACHERS
PRB_DSRP = 2.5 * tsc267 PROBLEM: STUDENT DISRESPECT FOR TEACHERS
PRB_RACE = 2.5 * tsc274 PROBLEM: RACIAL TENSION
PRB_CULT = 2.5 * tsc275 PROBLEM: CULTURAL CONFLICT

I_SELFAB (INDEX-STUDENT SELF-ABUSIVE HBVR) is mean of following variables.

PRB_CTCL = 2.5 * tsc257 PROBLEM: STUDENTS CUTTING CLASS
PRB_PRGN = 2.5 * tsc261 PROBLEM: STUDENT PREGNANCY
PRB_ALCH = 2.5 * tsc262 PROBLEM: STUDENT USE OF ALCOHOL
PRB_DRUG = 2.5 * tsc263 PROBLEM: STUDENT DRUG ABUSE
PRB_DRPO = 2.5 * tsc268 PROBLEM: STUDENTS DROPPING OUT

I_SUPORT (INDEX-TEACHERS SUPPORT) is mean of following variables.
SAT_ADMN = 2.5 * tsc224SCHOOL ADMIN KNOWS PROBLEMS STAFF FACES
SAT_DISP = 2.5 * tsc225 ALL AT SCHOOL AGREE ON SCHOOL DISCIPLINE
SAT_PRNC = 2.5 * tsc227 PRINCIPAL ENFORCES RULES/BACKS TEACHERS
SUP_DISP = 2.5 * tsc237 SCHOOL AIDS NEW TEACHERS W/ STDNT DISCIP
SUP_INST = 2.5 * tsc238 SCHOOL AIDS NEW TEACHERS W/ INSTR METHOD
SAT_BHVR = 2.5 * tsc226 STDNT BEHAVIOR INTERFERES WITH TEACHING
SUP_CURR = 2.5 * tsc239 SCHOOL AIDS NEW TEACHERS W/ CURRICULUM
SUP_ADJT = 2.5 * tsc240 SCHOOL AIDS NEW TEACHERS W/ ADJUSTING

I_TSATSF (INDEX-TEACHERS SATISFACTION) is mean of following variables.
SAT_WORK = 2.5 * tsc222 I LOOK FORWARD TO WORKING AT THIS SCHOOL
SAT_ADVN = 2.5 * tsc232 TEACHING HAS MORE ADVAN THAN DISADVAN
XJOB = 5-SAT_JOB where (SATJOB=2*TSC233)
TSC233 (WOULD CHANGE JOBS IF COULD)
SAT_TAGN = 2.5 * tsc236WOULD BECOME A TEACHER AGAIN

I_TINFLU (INDEX-TEACHERS INFLUENCE IN POLICY) is mean of following variables.
INFL_CNT = 1.67 * tsc245 TCHRS INFLU W/ CONTENT OF INSERVICE PGMS
INFL_POL = 1.67 * tsc246 TCHRS INFLU W/ POLICY ON GROUPING STDNTS
INFL_CRR = 1.67 * tsc247 TCHRS INFLU W/ ESTABLISHING CURRICULUM
CNTR_TXT = 1.67 * tsc248 TEACHERS CONTROL SELECT INSTR MATERIAL

I_TCNTRL (INDEX-TEACHERS CONTROL) is mean of following variables.

CNTR_TCH = 1.67 * tsc250	TCHRS CONTROL SELECT TEACHING TECHNIQUES
CNTR_GRD = 1.67 * tsc251	TCHRS CONTROL EVALUATING/GRADING STDNTS
CNTR_DIS = 1.67 * tsc252	TCHRS CONTROL DISCIPLINING STDNTS
CNTR_HWK = 1.67 * tsc253	TCHRS CONTROL AMOUNT OF HOMEWORK ASSIGND

I_STDFAM (INDEX-STUDENTS FAMILY PROBLEMS) is mean of following variables.

PRB_PRNT = 2.5 * tsc271	PROBLEM: LACK OF PARENT INVOLVEMENT
PRB_PALC = 2.5 * tsc272	PROBLEM: PARENT ALCOHOL &/OR DRUG ABUSE
PRB_PVRY = 2.5 * tsc273	PROBLEM: POVERTY

Construction of Out-of-Field Variable

The measure of out-of-field teaching utilized in this analysis was the percentage of the teacher's entire assignment or class schedule in which they taught in field for which he/she did not have at least a minor in his/her undergraduate program. This measure applies only for secondary teachers providing departmentalized courses. No similar measure is calculated for elementary teachers. For these teachers, a variable indicating that no out-of-field measure was available was included in the analysis. A more detailed discussion of the derivation of this out-of-field variable may be found in Ingersoll (1995).

Choice of Dependent Variable—Academic and Supplemental Compensation

The dependent variable in this hedonic wage analysis included the sum of the academic year salary (TSC292) plus additional compensation for extra curricular or other activities (TSC294).[4] The purpose of the hedonic wage model is to explain the patterns of variation in the total monetary compensation with respect to the characteristics of teachers, their jobs and job assignments, the schools and districts in which they teach, and the regions in which they live and work. What is the total compensation being offered to each individual in exchange for their services? To use only base pay as the dependent variable ignores one potentially important form of compensation for each individual.

In fact, it is through these various forms of additional compensation that school districts can get around some of the constraints of the lockstep salary scales which are common in public schools. One cannot be sure that the additional compensation is entirely separable from base pay and that it is being paid entirely for the extra curricular activity specified. Is the assignment of teachers to these activities for which they receive additional compensation in any way associated

4 The variable name in parentheses are the names used in the SASS dataset provided by NCES for this analysis.

with other teacher attributes or behaviors? These additional assignments and the compensation that goes with them may be a potential way of rewarding teachers who possess other desirable characteristics.

Although it is believed that using only academic salary as the dependent variable in this analysis is not correct, it is still instructive to estimate the same equation as was used in the original analysis (table B.2), but to replace the dependent variable with the nature log of academic salary only (i.e., excluding extra pay for additional activities). The parameter estimates for this new equation are presented in table B.4, and the coefficients between these two equations are compared. Of the 129 coefficients, 64 change by less than 10 percent. Only 23 change by more than 50 percent and many of these are among the coefficients that are not statistically significant in the original equation. None of the statistically significant variables included in the calculation of the TCI change by more than 20 percent with most changing by substantially less than 10 percent.

Some of the more interesting variables that do change magnitudes when focusing on academic versus total salary payments are listed below.

Coefficients from the equation using: (t-ratios are in parentheses)

	Log total salary	Log academic salary
Teacher is a white male	.05197 (14.39)	.02718 (8.06)
BA major is PE	.04803 (7.14)	.01294 (2.00)
Teacher is secondary	.02427 (3.10)	.01251 (1.48)
Nonschool time spent on school related activities	.00107 (5.40)	.00013 (0.67)

Note that the coefficients each of the four variables are smaller in the equation which includes only academic salary in the dependent variable. For example, these results suggest that the academic salary differential between white females and white males is smaller than the overall salary differential when additional pay is included in the dependent variable. The .02718 coefficient implies about a 2.7 percent differential, while the .05197 coefficient implies about a 5.2 percent differential. Nevertheless, in both cases the salary differential for white males is statistically significant. Similarly, the effects of having an undergraduate degree in PE and being a secondary teacher decline when additional pay is excluded from the dependent variable. This suggests that at least some of those who are receiving the additional pay for extracurricular work are white male, PE teachers in high schools. In addition, it appears as though those individuals spending additional nonschool time on school related activities are also among those who are likely to be receiving additional pay over and above the regular academic salary.

Enrollment and Distance from Central City: The Use of Dummy Variables

Continuous variables were used in early stages of the analysis for both enrollment and distance from the central city. However, the relationships are sufficiently complex that dummy variables permit exploration of alternative patterns of variation that are difficult to achieve with various functional forms of these independent variables. A kind of threshold effect is observed in both cases: that is, once a certain value of the independent variable is reached, no further difference in salaries of teachers is observed, all else equal. For enrollment, after a certain size was reached, the variations in teacher salaries are not very large. Similarly, it wasn't until one reaches a certain minimum distance from central cities that there was any statistically significant effect on salaries. The dummy variables reveal this threshold effect more clearly and indicate the ranges in which changes in the enrollment or distance from central city are associated with virtually no difference in teacher salaries.

Appendix B

Descriptive Statistics and Parameter Estimates
Variables Included in the Teacher Salary Regressions

In table B.1, the mean values of the dependent and independent variables included in the salary equation are presented. Table B.2 presents the parameter estimates and corresponding standard errors for the teacher salary regression equation. Table B.3 presents the parameter estimates of the replication of the Barro model of teacher salaries. Table B.4 compares the parameter estimates for the hedonic salary regression presented in Table B.2 with the parameter estimates obtained using the same set of independent variables with an alternative dependent variable. The original equation in Table B.2 uses the natural log of the sum of academic salary and additional pay for extra duty. The alternative dependent variable is the natural log of academic salary only.

Table B.1— Mean values and standard errors for dependent and independent variables used in the regression analyses: United States, 1990–91

Variables	Mean Values	Standard Errors
DEPENDENT VARIABLES		
LOG(ACADEMIC+SUPPLEMENTAL SALARY,90-91)	10.30	0.0034
UNLOG(ACADEMIC+SUPPLEMENTAL SALARY,90-91)	29,709.03	
INDEPENDENT VARIABLES		
(A) Discretionary Factors		
TCHR IS ASIAN MALE	0.00	0.0002
TCHR IS BLACK MALE	0.02	0.0014
TCHR IS HISPANIC MALE	0.01	0.0008
TCHR IS AMER IND/ALSKN NATV MALE	0.00	0.0003
TCHR IS WHITE MALE	0.25	0.0033
TCHR IS ASIAN FEMALE	0.01	0.0006
TCHR IS BLACK FEMALE	0.06	0.0024
TCHR IS HISPANIC FEMALE	0.03	0.0014
TCHR IS AMER IND/ALSKN NATV FEMALE	0.01	0.0005
CURRENT MARITAL STATUS	0.73	0.0037
MEMBER PROFESS TEACHER/ED ORGANIZATION	0.85	0.0033
TEACHES < 1/4 TIME	0.01	0.0008
TEACHES AT LEAST 1/4, NOT 1/2	0.01	0.0009
TEACHES AT LEAST 1/2, NOT 3/4	0.03	0.0016
TEACHES AT LEAST 3/4, NOT FULL-TIME	0.01	0.0008
MAIN ASGNMNT ITINERATE TCHR	0.04	0.0017
MAIN ASGNMNT LONG TERM SUBST. TCHR	0.00	0.0008
AGE AS OF 1991	42.56	0.0768
AGE AS OF 1991 - SQUARED	1,901.57	6.9414
NUM OF BREAKS IN SERVICE OF 1 YR OR MORE	0.47	0.0062
YRS SINCE BEGAN TCHNG IN THIS SCHOOL	9.43	0.0678
YRS SINCE BEGAN TCHNG IN THIS SCHOOL-SQD	150.33	1.8780
YRS SINCE BEGAN FIRST TCHNG POSITION	17.04	0.0687
YRS SINCE BEGAN 1ST TCHNG POSITION-SQD	384.95	2.7270
BA MAJOR IN EDUCATION-BILINGUAL	0.00	0.0003
BA MAJOR IN EDUCATION-EARLY CHILDHD	0.02	0.0014
BA MAJOR IN EDUCATION-GENERAL SECONDARY	0.02	0.0008
BA MAJOR IN EDUCATION-SPEC EDUC	0.06	0.0017
BA MAJOR IN ART EDUC	0.01	0.0008
BA MAJOR IN BUSINESS EDUC	0.02	0.0009
BA MAJOR IN ENGLISH EDUC	0.04	0.0013
BA MAJOR IN FOREIGN LANG EDUC	0.01	0.0005
BA MAJOR IN MATH EDUC	0.02	0.0008
BA MAJOR IN MISC EDUC	0.00	0.0004
BA MAJOR IN MUSIC EDUC	0.03	0.0013
BA MAJOR IN NATURAL SCIENCE EDUC	0.01	0.0008
BA MAJOR IN PHYSICAL EDUCATION	0.06	0.0021
BA MAJOR IN SOCIAL SCI EDUC	0.02	0.0009
BA MAJOR IN VOCATIONAL EDUC	0.02	0.0008
BA MAJOR IN ART	0.01	0.0007
BA MAJOR IN BUSINESS	0.01	0.0007

Level of significance: * = .05, ** = .01. The significance levels test whether these estimates are different from zero.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table B.1— Mean values and standard errors for dependent and independent variables used in the regression analyses: United States, 1990–91—Continued

Variables	Mean Values	Standard Errors
BA MAJOR IN ENGLISH	0.04	0.0017
BA MAJOR IN FOREIGN LANGUAGES	0.02	0.0010
BA MAJOR IN HUMANITIES	0.00	0.0005
BA MAJOR IN MATH	0.02	0.0009
BA MAJOR IN MISCELLANEOUS SUBJECTS	0.00	0.0005
BA MAJOR IN MUSIC	0.01	0.0008
BA MAJOR IN NATURAL SCIENCES	0.04	0.0014
BA MAJOR IN PERFORMING ARTS	0.00	0.0004
BA MAJOR IN SOCIAL SCIENCES	0.08	0.0027
BA MAJOR IN A VOCATIONAL SUBJECT	0.01	0.0004
HAS ADVANCED PROFESSIONAL TCHG CERTIFICA	0.15	0.0028
HAS PROBATIONARY CERTIFICATE	0.03	0.0012
HAS TEMPORARY CERTIFICATE	0.03	0.0013
NO TCHING CERTIFICATE	0.03	0.0014
HIGHEST DEGREE IS NONE	0.00	0.0004
HIGHEST DEGREE IS ASSOC ARTS	0.00	0.0003
HIGHEST DEGREE IS MASTERS	0.42	0.0039
HIGHEST DEGREE IS ED SEPC CERT	0.05	0.0019
HIGHEST DEGREE IS DOCTORATE	0.01	0.0007
TEACHER IS SECONDARY LEVEL	0.49	0.0054
LOG (CLSZINDX)	-0.08	0.0044
UNLOG (CLSZINDX)	0.93	
CURRENTLY MASTER OR MENTOR TEACHER	0.11	0.0021
% TIME TEACHING OUT OF FIELD	10.55	0.2509
OUT-OF-FIELD VALUE NOT APPLICABLE	0.54	0.0063
% TCHG TIME W/ HIGH ACHVG STUDENTS	14.26	0.3049
% TCHG TIME W/ LOW ACHVG STUDENTS	20.39	0.3435
NON-SCHL TIME SPENT ON SCH-RELATED ACTVS	11.14	0.0668
ASSIGNED HOMEWORK IN RECENT WEEK	0.41	0.0057
INDEX-STUDENT SELF-ABUSIVE BHVR	8.08	0.0247
INDEX-STUDENTS FAMILY PROBLEMS	6.08	0.0232
INDEX-TEACHERS SUPPORT	5.24	0.0125
INDEX-TEACHERS CONTROL	8.78	0.0113
INDEX-TEACHERS INFLUENCE IN POLICY	6.14	0.0149
INDEX-TEACHERS SATISFACTION	2.37	0.0110
INDEX-VIOLENT STUDENT BEHAVIOR	7.89	0.0149
% STUDENTS ARE: ASIAN/PAC ISL, SCH	2.60	0.0957
% STUDENTS ARE: BLACK/NONHISP, SCH	15.14	0.3075
% STUDENTS ARE: HISPANIC, SCH	9.87	0.3471
% STUDENTS ARE: AM INDIAN/ALASKAN, SCH	1.10	0.0322
RACE_ASN*PENRASNS	0.36	0.0358
RACE_BLK*PENRBLKS	4.11	0.1758
RACE_HIS*PENRHISS	1.60	0.1360
RACE_NAT*PENRNATS	0.11	0.0095
% STUDENTS ABSENT ON A RECENT DAY, SCH	6.37	0.0540
SCHOOL IS SPECIAL EDUCATION	0.01	0.0009
SCHOOL IS VOCATIONAL/TECH	0.01	0.0009
SCHOOL IS ALTERNATIVE	0.01	0.0026
INDEX OF ADMISSION REQUIREMENTS	0.19	0.0085

Level of significance: * = .05, ** = .01. The significance levels test whether these estimates are different from zero.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table B.1— Mean values and standard errors for dependent and independent variables used in the regression analyses: United States, 1990–91—Continued

Variables	Mean Values	Standard Errors
(B) Cost Factors—District Level		
DIST ENROLLMENT:501-1,000	0.06	0.0038
DIST ENROLLMENT:1,001-5,000	0.34	0.0073
DIST ENROLLMENT:5,001-10,000	0.16	0.0061
DIST ENROLLMENT:10,001-25,000	0.16	0.0057
DIST ENROLLMENT:25,001-50,000	0.08	0.0037
DIST ENROLLMENT:50,001-100,000	0.06	0.0026
DIST ENROLLMENT:MORE THAN 100,000	0.09	0.0039
% DIST K-12 STDS: ASIAN/PACFC	2.74	0.0824
% DIST K-12 STDS: BLACK NONHISPNC	14.69	0.2105
% DIST K-12 STDS: HISPANIC	10.07	0.2847
% DIST K-12 STDS: AMIND/ALASKAN	1.09	0.0361
RACE_ASN*PENRASND	0.33	0.0209
RACE_BLK*PENRBLKD	3.58	0.1389
RACE_HIS*PENRHISD	1.45	0.1132
RACE_NAT*PENRNATD	0.10	0.0097
% CHG IN DIST. ENR 89 TO 90, DIS	1.79	0.0699
(C) Cost Factors—County Level		
% OF COUNTY ENR IN LARGEST DIST IN COUNTY	54.22	0.3624
CLOSEST CENTRAL CITY IS 10-20 MILES	0.22	0.0071
CLOSEST CENTRAL CITY IS 20-40 MILES	0.21	0.0054
CLOSEST CENTRAL CITY IS 40-80 MILES	0.16	0.0049
CLOSEST CENTRAL CITY IS 80-160 MILES	0.05	0.0028
CLOSEST CENTRAL CITY IS > 160 MILES	0.01	0.0005
DISTRICT < 75 MILES OF 2 CENTRAL CITIES	0.15	0.0038
DISTRICT < 75 MILES OF 3 CENTRAL CITIES	0.64	0.0059
% CHANGE, COUNTY POPULATION 1980–90	10.50	0.2336
LOG AVG VALUE FARM LAND/BLDG/ACRE, 87	7.13	0.0099
UNLOG AVG VALUE FARM LAND/BLDG/ACRE, 87	1,253.88	
NAT LOG COUNTY POPULATION DENSITY, 1990	5.65	0.0281
UNNAT LOG COUNTY POPULATION DENSITY, 1990	283.37	
SQUARE OF NAT LOG CNTY POP DENSITY, 1990	35.23	0.3482
LOG POP MSA/PMSA AREA OR NONMET COUNTY	12.76	0.0304
UNLOG POP MSA/PMSA AREA OR NONMET COUNTY	348,793.58	
SQUARE OF LOG POP MSA/PMSA AREA/NONMET CO	166.63	0.7797
CIVILIAN LABOR FORCE UNEMPLOYMENT RATE,8	5.62	0.0310
MEAN TEMPERATURE (30 YRS NORMAL)	56.15	0.0795
AVG SNOW IN. (30 YRS NORMAL)	23.16	0.2836
# OF BANKS PER 100,000 POPULATION, 86	10.05	0.1287
# VIOLENT CRIMES PER 100,000 POPULATION	523.50	7.1810

Level of significance: * = .05, ** = .01. The significance levels test whether these estimates are different from zero.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table B.2— Parameter estimates for the hedonic salary regression equation with the dependent variable equal to the natural log of the sum of academic salary and additional pay for extra duty

	Coefficient (t ratio)
INTERCEPT	9.8997**
(A) DISCRETIONARY FACTORS	
TCHR IS ASIAN MALE	0.0256 (1.1800)
TCHR IS BLACK MALE	0.0090 (0.6747)
TCHR IS HISPANIC MALE	0.0574** (2.7572)
TCHR IS AMER IND/ALSKN NATV MALE	-0.0051 (-0.0926)
TCHR IS WHITE MALE	0.0520** (14.3907)
TCHR IS ASIAN FEMALE	0.0216 (1.3379)
TCHR IS BLACK FEMALE	-0.0195 (-1.3997)
TCHR IS HISPANIC FEMALE	0.0020 (0.1997)
TCHR IS AMER IND/ALSKN NATV FEMALE	-0.0408 (-1.9281)
TCHR IS WHITE FEMALE	*(Comparison Group)*
CURRENT MARITAL STATUS	-0.0124** (-3.4765)
MEMBER PROFESS TEACHER/ED ORGANIZATION	0.0333** (6.4388)
TEACHES < 1/4 TIME	-0.6147** (-7.9069)
TEACHES AT LEAST 1/4, NOT 1/2	-0.5127** (-14.1326)
TEACHES AT LEAST 1/2, NOT 3/4	-0.4233** (-23.5724)
TEACHES AT LEAST 3/4, NOT FULL-TIME	-0.2549** (-11.8710)
TEACHES FULL-TIME	*(Comparison Group)*
MAIN ASGNMNT ITINERATE TCHR	0.3475** (13.6509)
MAIN ASGNMNT LONG TERM SUBST. TCHR	-0.1693** (-4.5205)
AGE AS OF 1991	0.0029* (1.9774)
AGE AS OF 1991 - SQUARED	-0.0000 (-1.6115)
NUM OF BREAKS IN SERVICE OF 1 YR OR MORE	-0.0291** (-10.3988)
YRS SINCE BEGAN TCHNG IN THIS SCHOOL	0.0087** (9.7954)

Level of significance: * = .05, ** = .01. The significance levels test whether these estimates are different from zero.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table B.2— Parameter estimates for the hedonic salary regression equation with the dependent variable equal to the natural log of the sum of academic salary and additional pay for extra duty—Continued

	Coefficient (t ratio)
YRS SINCE BEGAN TCHNG IN THIS SCHOOL-SQD	-0.0002** (-5.1090)
YRS SINCE BEGAN FIRST TCHNG POSITION	0.0213** (23.5312)
YRS SINCE BEGAN 1ST TCHNG POSITION-SQD	-0.0003** (-12.4082)
BA MAJOR IN EDUCATION-GENERAL ELEMENTARY	*(Comparison Group)*
BA MAJOR IN EDUCATION-BILINGUAL	-0.0139 (-0.7685)
BA MAJOR IN EDUCATION-EARLY CHILDHD	0.0118 (1.2367)
BA MAJOR IN EDUCATION-GENERAL SECONDARY	0.0043 (0.4548)
BA MAJOR IN EDUCATION-SPEC EDUC	0.0083 (0.9377)
BA MAJOR IN ART EDUC	-0.0060 (-0.4723)
BA MAJOR IN BUSINESS EDUC	0.0162* (2.0847)
BA MAJOR IN ENGLISH EDUC	-0.0062 (-0.6836)
BA MAJOR IN FOREIGN LANG EDUC	-0.0176 (-0.9791)
BA MAJOR IN MATH EDUC	-0.0054 (-0.4674)
BA MAJOR IN MISC EDUC	0.0093 (0.4298)
BA MAJOR IN MUSIC EDUC	0.0178 (1.1863)
BA MAJOR IN NATURAL SCIENCE EDUC	-0.0146 (-1.0655)
BA MAJOR IN PHYSICAL EDUCATION	0.0480** (7.1449)
BA MAJOR IN SOCIAL SCI EDUC	-0.0087 (-0.8331)
BA MAJOR IN VOCATIONAL EDUC	0.0298** (3.2566)
BA MAJOR IN ART	0.0015 (0.0699)
BA MAJOR IN BUSINESS	0.0288 (1.9524)
BA MAJOR IN ENGLISH	0.0086 (0.9310)
BA MAJOR IN FOREIGN LANGUAGES	-0.0095 (-0.6096)
BA MAJOR IN HUMANITIES	-0.0224 (-0.7218)

Level of significance: * = .05, ** = .01. The significance levels test whether these estimates are different from zero.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table B.2— Parameter estimates for the hedonic salary regression equation with the dependent variable equal to the natural log of the sum of academic salary and additional pay for extra duty—Continued

	Coefficient (t ratio)
BA MAJOR IN MATH	0.0234* (2.1903)
BA MAJOR IN MISCELLANEOUS SUBJECTS	0.0910** (5.1368)
BA MAJOR IN MUSIC	0.0395* (2.2961)
BA MAJOR IN NATURAL SCIENCES	0.0044 (0.5209)
BA MAJOR IN PERFORMING ARTS	0.0257 (1.3784)
BA MAJOR IN SOCIAL SCIENCES	0.0215** (3.3951)
BA MAJOR IN A VOCATIONAL SUBJECT	0.0292 (1.8390)
HAS ADVANCED PROFESSIONAL TCHG CERTIFICATE	0.0125** (2.6607)
HAS STANDARD TCHG CERTIFICATE	*(Comparison Group)*
HAS PROBATIONARY CERTIFICATE	-0.0248* (-2.3873)
HAS TEMPORARY CERTIFICATE	-0.0105 (-1.0729)
NO TCHING CERTIFICATE	-0.0311** (-2.7917)
HIGHEST DEGREE IS NONE	0.0140 (0.7895)
HIGHEST DEGREE IS ASSOC ARTS	0.0528 (1.8066)
HIGHEST DEGREE IS BACHELORS	*(Comparison Group)*
HIGHEST DEGREE IS MASTERS	0.1071** (23.5183)
HIGHEST DEGREE IS ED SEPC CERT	0.1300** (16.6918)
HIGHEST DEGREE IS DOCTORATE	0.1617** (7.9040)
TEACHER IS SECONDARY LEVEL	0.0243** (3.0987)
LOG (INDEX OF CLASS SIZE)	0.0122** (2.6318)
CURRENTLY MASTER OR MENTOR TEACHER	0.0094 (1.7824)
% TIME TEACHING OUT OF FIELD	0.0001 (1.0978)
OUT-OF-FIELD VALUE NOT APPLICABLE	-0.0064 (-0.9744)
% TCHG TIME W/ HIGH ACHVG STUDENTS	0.0001* (2.0084)

Level of significance: * = .05, ** = .01. The significance levels test whether these estimates are different from zero.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table B.2— Parameter estimates for the hedonic salary regression equation with the dependent variable equal to the natural log of the sum of academic salary and additional pay for extra duty—Continued

	Coefficient (t ratio)
% TCHG TIME W/ LOW ACHVG STUDENTS	-0.0000 (-0.3140)
NON-SCHL TIME SPENT ON SCH-RELATED ACTVS	0.0011** (5.4042)
ASSIGNED HOMEWORK IN RECENT WEEK	0.0150** (2.8620)
INDEX-STUDENT SELF-ABUSIVE BEHAVIOR	0.0017 (1.4495)
INDEX-STUDENTS FAMILY PROBLEMS	0.0052** (5.4695)
INDEX-TEACHERS SUPPORT	0.0067** (4.5862)
INDEX-TEACHERS CONTROL	0.0023 (1.5052)
INDEX-TEACHERS INFLUENCE IN POLICY	0.0031** (2.7604)
INDEX-TEACHERS SATISFACTION	-0.0037** (-4.1089)
INDEX-VIOLENT STUDENT BEHAVIOR	-0.0049** (-3.3275)
% STUDENTS ARE: ASIAN/PAC ISL, SCH	0.0009 (1.3423)
% STUDENTS ARE: BLACK/NONHISP, SCH	0.0002 (1.2967)
% STUDENTS ARE: HISPANIC, SCH	0.0007* (2.3631)
% STUDENTS ARE: AM INDIAN/ALASKAN, SCH	-0.0000 (-0.0056)
RACE_ASN*PENRASNS	-0.0018* (-2.4286)
RACE_BLK*PENRBLKS	-0.0006 (-1.6342)
RACE_HIS*PENRHISS	-0.0005 (-0.8349)
RACE_NAT*PENRNATS	0.0001 (0.2225)
% STUDENTS ABSENT ON A RECENT DAY, SCH	0.0002 (0.3784)
SCHOOL IS SPECIAL EDUCATION	0.0262 (1.6890)
SCHOOL IS VOCATIONAL/TECH	0.0110 (0.7276)
SCHOOL IS ALTERNATIVE	0.0412 (1.7121)
INDEX OF ADMISSION REQUIREMENTS	-0.0031 (-0.6664)

Level of significance: * = .05, ** = .01. The significance levels test whether these estimates are different from zero.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table B.2— Parameter estimates for the hedonic salary regression equation with the dependent variable equal to the natural log of the sum of academic salary and additional pay for extra duty—Continued

	Coefficient (t ratio)
(B) COST FACTORS—DISTRICT LEVEL	
DIST ENROLLMENT: LESS THAN 501	*(Comparison Group)*
DIST ENROLLMENT: 501-1,000	0.0577** (4.8124)
DIST ENROLLMENT: 1,001-5,000	0.1032** (9.8898)
DIST ENROLLMENT: 5,001-10,000	0.1271** (9.7670)
DIST ENROLLMENT: 10,001-25,000	0.1179** (8.3882)
DIST ENROLLMENT: 25,001-50,000	0.1048** (6.6457)
DIST ENROLLMENT: 50,001-100,000	0.0860** (5.4543)
DIST ENROLLMENT: >100,001	0.1209** (7.3044)
% DIST K-12 STDS: ASIAN/PACFC ISL	0.0021* (2.3782)
% DIST K-12 STDS: BLACK NONHISPNC	-0.0003 (-1.2761)
% DIST K-12 STDS: HISPANIC	0.0005 (1.7646)
% DIST K-12 STDS: AMIND/ALASKAN	0.0004 (0.9598)
RACE_ASN *PENRASND	-0.0007 (-0.6651)
RACE_BLK *PENRBLKD	0.0008 (1.8060)
RACE_HIS *PENRHISD	0.0006 (1.0113)
RACE_NAT *PENRNATD	0.0001 (0.2002)
% CHG IN DIST. ENR 89 TO 90, DIS	0.0009 (1.6295)
(C) COST FACTORS—REGIONAL LEVEL	
% OF COUNTY ENR IN LARGEST DIST IN COUNTY	-0.0008** (-9.2328)
CLOSEST CENTRAL CITY IS LESS THAN 10 MILES	*(Comparison Group)*
CLOSEST CENTRAL CITY IS 10-20 MILES	-0.0025 (-0.3453)
CLOSEST CENTRAL CITY IS 20-40 MILES	0.0026 (0.3989)
CLOSEST CENTRAL CITY IS 40-80 MILES	0.0082 (1.1541)

Level of significance: * = .05, ** = .01. The significance levels test whether these estimates are different from zero.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table B.2— Parameter estimates for the hedonic salary regression equation with the dependent variable equal to the natural log of the sum of academic salary and additional pay for extra duty—Continued

	Coefficient (t ratio)
CLOSEST CENTRAL CITY IS 80-160 MILES	0.0164
	(1.4179)
CLOSEST CENTRAL CITY IS > 160 MILES	0.0613**
	(3.8054)
DISTRICT < 75 MILES OF 2 CENTRAL CITIES	-0.0051
	(-1.0003)
DISTRICT < 75 MILES OF 3 CENTRAL CITIES	0.0220**
	(3.5409)
% CHANGE, COUNTY POPULATION 1980–90	0.0009**
	(6.2575)
LOG AVG VALUE FARM LAND/BLDG/ACRE, 87	0.0566**
	(14.9341)
NAT LOG COUNTY POPULATION DENSITY, 1990	-0.0693**
	(-10.0267)
SQUARE OF NAT LOG CNTY POP DENSITY, 1990	0.0057**
	(8.8194)
LOG POP MSA/PMSA AREA OR NONMET COUNTY	-0.0640**
	(-2.6248)
SQUARE OF LOG POP MSA/PMSA AREA/NONMET CO	0.0035**
	(3.6508)
CIVILIAN LABOR FORCE UNEMPLOYMENT RATE,8	-0.0046**
	(-3.7985)
MEAN TEMPERATURE (30 YRS NORMAL)	-0.0035**
	(-8.1845)
AVG SNOW IN. (30 YRS NORMAL)	0.0006**
	(3.3637)
# OF BANKS PER 100,000 POPULATION, 86	-0.0028**
	(-9.2820)
# VIOLENT CRIMES PER 100,000 POPULATION,	0.0000**
	(3.6571)
Number of Cases	40,484
R-Squared	0.6266
Adj R-squared	0.6254
F-test	546.1310
(Prob>F)	0.0001

Level of significance: * = .05, ** = .01. The significance levels test whether these estimates are different from zero.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table B.3— Parameter estimates for Barro model of teacher salaries

Variables	Coefficient (t ratio)
Intercept	9.9240**
	(1,874.9619)
HIGHEST DEGREE IS ASSOC ARTS	0.0809**
	(3.0014)
HIGHEST DEGREE IS ED SEPC CERT	0.2085**
	(14.4588)
HIGHEST DEGREE IS MASTERS	0.1520**
	(17.6351)
HIGHEST DEGREE IS NONE	0.0630**
	(3.3016)
HIGHEST DEGREE IS DOCTORATE	0.2727**
	(13.9467)
YRS SINCE BEGAN TCHNG IN THIS SCHOOL	0.0087**
	(7.6512)
YRS SINCE BEGAN TCHNG IN THIS SCHOOL-SQD	-0.0001**
	(-3.0761)
YRS SINCE BEGAN FIRST TCHNG POSITION	0.0231**
	(28.0075)
YRS SINCE BEGAN 1ST TCHNG POSITION-SQD	-0.0003**
	(-15.0265)
TYRS_SCH*(HDEG_PH+HDEG_ES+HDEG_MA)	-0.0009
	(-0.5155)
HDEGTYRS SQUARED	0.0000
	(0.6385)
HAS ADVANCED PROFESSIONAL TCHG CERTIFICA	-0.0332**
	(-6.0675)
HAS PROBATIONARY CERTIFICATE	0.0028
	(0.3793)
HAS TEMPORARY CERTIFICATE	0.0306**
	(3.0617)
NO TCHING CERTIFICATE	0.0216
	(1.7271)
Number of Cases	42,738
R-Squared	0.3884
Adj R-squared	0.3881
F-test	1,808.3860
(Prob>F)	0.0001

Level of significance: * = .05, ** = .01. The significance levels test whether these estimates are different from zero.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table B.4— A comparison of the parameter estimates for the Hedonic Salary Regressions using alternative dependent variables

	Parameter Estimates from:			
Variables	Original Equation (Table B.2) (1)	Equation using Log Academic Salary as dependent variable (2)	Absolute Difference between Parameters (1) - (2) (3)	% Difference between Parameters (3) ÷ (1) (4)
INTERCEPT	9.89971	9.88920	0.010518	0.11
(A) DISCRETIONARY FACTORS				
TCHR IS ASIAN MALE	0.02562	0.01857	0.007050	27.52
TCHR IS BLACK MALE	0.00899	-0.00123	0.010222	113.70
TCHR IS HISPANIC MALE	0.05744	0.04233	0.015109	26.30
TCHR IS AMER IND/ALSKN NATV MALE	-0.00513	-0.03070	0.025566	-498.49
TCHR IS WHITE MALE	0.05197	0.02718	0.024785	47.69
TCHR IS ASIAN FEMALE	0.02160	0.02054	0.001061	4.91
TCHR IS BLACK FEMALE	-0.01950	-0.02180	0.002301	-11.80
TCHR IS HISPANIC FEMALE	0.00202	0.00347	-0.001450	-71.73
TCHR IS AMER IND/ALSKN NATV FEMALE	-0.04076	-0.03743	-0.003329	8.17
TCHR IS WHITE FEMALE		*(Comparison Group)*		
CURRENT MARITAL STATUS	-0.01238	-0.01230	-0.000081	0.65
MEMBER PROFESS TEACHER/ED ORGANIZATION	0.03334	0.03276	0.000578	1.74
TEACHES < 1/4 TIME	-0.61472	-0.62063	0.005905	-0.96
TEACHES AT LEAST 1/4, NOT 1/2	-0.51266	-0.52766	0.015002	-2.93
TEACHES AT LEAST 1/2, NOT 3/4	-0.42327	-0.42788	0.004609	-1.09
TEACHES AT LEAST 3/4, NOT FULL-TIME	-0.25493	-0.26083	0.005899	-2.31
TEACHES FULL-TIME		*(Comparison Group)*		
MAIN ASGNMNT ITINERATE TCHR	0.34750	0.35214	-0.004639	-1.33
MAIN ASGNMNT LONG TERM SUBST. TCHR	-0.16928	-0.16495	-0.004334	2.56
AGE AS OF 1991	0.00285	0.00466	-0.001810	-63.42
AGE AS OF 1991 - SQUARED	-0.00003	-0.00004	0.000014	-53.88
NUM OF BREAKS IN SERVICE OF 1 YR OR MORE	-0.02906	-0.02845	-0.000609	2.10
YRS SINCE BEGAN TCHNG IN THIS SCHOOL	0.00873	0.00849	0.000243	2.78
YRS SINCE BEGAN TCHNG IN THIS SCHOOL-SQD	-0.00016	-0.00015	-0.000011	6.94
YRS SINCE BEGAN FIRST TCHNG POSITION	0.02128	0.02127	0.000015	0.07
YRS SINCE BEGAN 1ST TCHNG POSITION-SQD	-0.00031	-0.00031	0.000002	-0.79
BA MAJOR IN EDUCATION-GENERAL ELEMENTARY		*(Comparison Group)*		
BA MAJOR IN EDUCATION-BILINGUAL	-0.01386	-0.01032	-0.003536	25.52
BA MAJOR IN EDUCATION-EARLY CHILDHD	0.01176	0.01189	-0.000130	-1.11
BA MAJOR IN EDUCATION-GENERAL SECONDARY	0.00430	0.00336	0.000942	21.89
BA MAJOR IN EDUCATION-SPEC EDUC	0.00832	0.00850	-0.000176	-2.12
BA MAJOR IN ART EDUC	-0.00597	0.00336	-0.009336	156.25
BA MAJOR IN BUSINESS EDUC	0.01619	0.01490	0.001293	7.98

SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table B.4— A comparison of the parameter estimates for the Hedonic Salary Regressions using alternative dependent variables—Continued

Variables	Parameter Estimates from: Original Equation (Table B.2) (1)	Equation using Log Academic Salary as dependent variable (2)	Absolute Difference between Parameters (1) - (2) (3)	% Difference between Parameters (3) ÷ (1) (4)
BA MAJOR IN ENGLISH EDUC	-0.00624	-0.00196	-0.004281	68.62
BA MAJOR IN FOREIGN LANG EDUC	-0.01762	-0.00519	-0.012435	70.56
BA MAJOR IN MATH EDUC	-0.00538	0.00057	-0.005956	110.66
BA MAJOR IN MISC EDUC	0.00927	0.01737	-0.008096	-87.30
BA MAJOR IN MUSIC EDUC	0.01775	-0.00186	0.019611	110.48
BA MAJOR IN NATURAL SCIENCE EDUC	-0.01456	-0.00547	-0.009084	62.40
BA MAJOR IN PHYSICAL EDUCATION	0.04803	0.01294	0.035089	73.05
BA MAJOR IN SOCIAL SCI EDUC	-0.00869	-0.00615	-0.002539	29.23
BA MAJOR IN VOCATIONAL EDUC	0.02982	0.03467	-0.004852	-16.27
BA MAJOR IN ART	0.00152	0.00908	-0.007555	-496.55
BA MAJOR IN BUSINESS	0.02878	0.02995	-0.001170	-4.07
BA MAJOR IN ENGLISH	0.00860	0.00996	-0.001361	-15.82
BA MAJOR IN FOREIGN LANGUAGES	-0.00948	-0.00135	-0.008126	85.72
BA MAJOR IN HUMANITIES	-0.02245	-0.02351	0.001059	-4.72
BA MAJOR IN MATH	0.02340	0.02959	-0.006185	-26.43
BA MAJOR IN MISCELLANEOUS SUBJECTS	0.09097	0.09061	0.000352	0.39
BA MAJOR IN MUSIC	0.03951	0.01830	0.021204	53.67
BA MAJOR IN NATURAL SCIENCES	0.00439	0.01112	-0.006727	-153.19
BA MAJOR IN PERFORMING ARTS	0.02567	0.01699	0.008678	33.81
BA MAJOR IN SOCIAL SCIENCES	0.02146	0.02159	-0.000125	-0.58
BA MAJOR IN A VOCATIONAL SUBJECT	0.02925	0.03140	-0.002157	-7.38
HAS ADVANCED PROFESSIONAL TCHG CERTIFICATE	0.01247	0.01225	0.000213	1.71
HAS STANDARD TCHG CERTIFICATE		*(Comparison Group)*		
HAS PROBATIONARY CERTIFICATE	-0.02480	-0.01981	-0.004995	20.14
HAS TEMPORARY CERTIFICATE	-0.01046	-0.00827	-0.002198	21.01
NO TCHING CERTIFICATE	-0.03110	-0.03157	0.000469	-1.51
HIGHEST DEGREE IS NONE	0.01398	0.00676	0.007214	51.62
HIGHEST DEGREE IS ASSOC ARTS	0.05277	0.06362	-0.010847	-20.56
HIGHEST DEGREE IS BACHELORS		*(Comparison Group)*		
HIGHEST DEGREE IS MASTERS	0.10711	0.10823	-0.001111	-1.04
HIGHEST DEGREE IS ED SEPC CERT	0.12996	0.13284	-0.002876	-2.21
HIGHEST DEGREE IS DOCTORATE	0.16172	0.17002	-0.008293	-5.13
TEACHER IS SECONDARY LEVEL	0.02427	0.01251	0.011764	48.46
LOG (INDEX OF CLASS SIZE)	0.01220	0.01052	0.001671	13.71
CURRENTLY MASTER OR MENTOR TEACHER	0.00935	0.00344	0.005915	63.26
% TIME TEACHING OUT OF FIELD	0.00007	0.00011	-0.000038	-56.70
OUT-OF-FIELD VALUE NOT APPLICABLE	-0.00636	-0.00077	-0.005585	87.86
% TCHG TIME W/ HIGH ACHVG STUDENTS	0.00012	0.00013	-0.000009	-7.55
% TCHG TIME W/ LOW ACHVG STUDENTS	-0.00001	-0.00001	-0.000007	48.16
NON-SCHL TIME SPENT ON SCH-RELATED ACTVS	0.00107	0.00013	0.000947	88.08
ASSIGNED HOMEWORK IN RECENT WEEK	0.01502	0.01505	-0.000031	-0.21
INDEX-STUDENT SELF-ABUSIVE BEHAVIOR	0.00172	0.00260	-0.000872	-50.62
INDEX-STUDENTS FAMILY PROBLEMS	0.00520	0.00535	-0.000149	-2.86
INDEX-TEACHERS SUPPORT	0.00670	0.00638	0.000322	4.81
INDEX-TEACHERS CONTROL	0.00226	0.00164	0.000619	27.44

SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table B.4— A comparison of the parameter estimates for the Hedonic Salary Regressions using alternative dependent variables—Continued

	Parameter Estimates from:			
	Original Equation (Table B.2)	Equation using Log Academic Salary as dependent variable	Absolute Difference between Parameters (1) - (2)	% Difference between Parameters (3) ÷ (1)
Variables	(1)	(2)	(3)	(4)
INDEX-TEACHERS INFLUENCE IN POLICY	0.00311	0.00276	0.000350	11.26
INDEX-TEACHERS SATISFACTION	-0.00368	-0.00230	-0.001380	37.52
INDEX-VIOLENT STUDENT BEHAVIOR	-0.00489	-0.00634	0.001448	-29.61
% STUDENTS ARE: ASIAN/PAC ISL, SCH	0.00087	0.00092	-0.000054	-6.27
% STUDENTS ARE: BLACK/NONHISP, SCH	0.00022	0.00023	-0.000010	-4.61
% STUDENTS ARE: HISPANIC, SCH	0.00070	0.00066	0.000043	6.10
% STUDENTS ARE: AM INDIAN/ ALASKAN, SCH	-0.00000	-0.00008	0.000074	-2908.25
RACE_ASN*PENRASNS	-0.00179	-0.00177	-0.000016	0.87
RACE_BLK*PENRBLKS	-0.00056	-0.00065	0.000091	-16.30
RACE_HIS*PENRHISS	-0.00046	-0.00053	0.000061	-13.21
RACE_NAT*PENRNATS	0.00014	0.00010	0.000049	33.92
% STUDENTS ABSENT ON A RECENT DAY, SCH	0.00019	0.00026	-0.000065	-33.84
SCHOOL IS SPECIAL EDUCATION	0.02619	0.02544	0.000751	2.87
SCHOOL IS VOCATIONAL/TECH	0.01102	0.01757	-0.006552	-59.47
SCHOOL IS ALTERNATIVE	0.04120	0.04878	-0.007585	-18.41
INDEX OF ADMISSION REQUIREMENTS	-0.00311	-0.00270	-0.000416	13.36
(B) COST FACTORS—DISTRICT LEVEL				
DIST ENROLLMENT: LESS THAN 501		*(Comparison Group)*		
DIST ENROLLMENT: 501-1,000	0.05770	0.05734	0.000360	0.62
DIST ENROLLMENT: 1,001-5,000	0.10325	0.10428	-0.001031	-1.00
DIST ENROLLMENT: 5,001-10,000	0.12710	0.12978	-0.002680	-2.11
DIST ENROLLMENT: 10,001-25,000	0.11791	0.11950	-0.001589	-1.35
DIST ENROLLMENT: 25,001-50,000	0.10478	0.10642	-0.001643	-1.57
DIST ENROLLMENT: 50,001-100,000	0.08596	0.08858	-0.002626	-3.05
DIST ENROLLMENT: ≥100,000	0.12087	0.11666	0.004205	3.48
% DIST K-12 STDS: ASIAN/PACFC ISL	0.00213	0.00225	-0.000120	-5.62
% DIST K-12 STDS: BLACK NONHISPNC	-0.00026	-0.00022	-0.000039	14.81
% DIST K-12 STDS: HISPANIC	0.00052	0.00053	-0.000011	-2.06
% DIST K-12 STDS: AMIND/ALASKAN	0.00042	0.00044	-0.000020	-4.81
RACE_ASN*PENRASND	-0.00065	-0.00068	0.000029	-4.37
RACE_BLK*PENRBLKD	0.00076	0.00087	-0.000109	-14.25
RACE_HIS*PENRHISD	0.00058	0.00062	-0.000034	-5.82
RACE_NAT*PENRNATD	0.00012	0.00012	0.000001	0.49
% CHG IN DIST. ENR 89 TO 90, DIS	0.00086	0.00079	0.000064	7.42
(C) COST FACTORS—REGIONAL LEVEL				
% OF TOT ENR FOR LARGEST DIST ENR	-0.00081	-0.00080	-0.000011	1.31
CLOSEST CENTRAL CITY IS <10 MILES		*(Comparison Group)*		
CLOSEST CENTRAL CITY IS 10-20 MILES	-0.00254	-0.00129	-0.001252	49.25
CLOSEST CENTRAL CITY IS 20-40 MILES	0.00264	0.00305	-0.000410	-15.50
CLOSEST CENTRAL CITY IS 40-80 MILES	0.00821	0.00825	-0.000039	-0.47
CLOSEST CENTRAL CITY IS 80-160 MILES	0.01636	0.02016	-0.003792	-23.18
CLOSEST CENTRAL CITY IS > 160 MILES	0.06128	0.06694	-0.005658	-9.23

SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table B.4— A comparison of the parameter estimates for the Hedonic Salary Regressions using alternative dependent variables—Continued

	Parameter Estimates from:			
	Original Equation (Table B.2)	Equation using Log Academic Salary as dependent variable	Absolute Difference between Parameters (1) - (2)	% Difference between Parameters (3) ÷ (1)
Variables	(1)	(2)	(3)	(4)
DISTRICT < 75 MILES OF 2 CENTRAL CITIES	-0.00510	-0.00528	0.000174	-3.40
DISTRICT < 75 MILES OF 3 CENTRAL CITIES	0.02196	0.02280	-0.000840	-3.82
% CHANGE, COUNTY POPULATION 1980–90	0.00090	0.00094	-0.000045	-5.04
LOG AVG VALUE FARM LAND/BLDG/ACRE, 87	0.05659	0.05693	-0.000339	-0.60
NAT LOG COUNTY POPULATION DENSITY, 1990	-0.06935	-0.06802	-0.001330	1.92
SQUARE OF NAT LOG CNTY POP DENSITY, 1990	0.00568	0.00555	0.000124	2.19
LOG POP MSA/PMSA AREA OR NONMET COUNTY	-0.06401	-0.07245	0.008444	-13.19
SQUARE OF LOG POP MSA/PMSA AREA/NONMET CO	0.00348	0.00380	-0.000319	-9.15 CIVILIAN
LABOR FORCE UNEMPLOYMENT RATE , 8	-0.00455	-0.00445	-0.000106	2.33
MEAN TEMPERATURE (30 YRS NORMAL)	-0.00351	-0.00324	-0.000269	7.67
AVG SNOW IN. (30 YRS NORMAL)	0.00060	0.00070	-0.000092	-15.20
# OF BANKS PER 100,000 POPULATION, 86	-0.00279	-0.00310	0.000311	-11.14
# VIOLENT CRIMES PER 100,000 POPULATION	0.00003	0.00003	-0.000001	-2.58

SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Appendix C

Standard Errors

Table C.1— Standard Errors for table 4.1A: State-by-state estimates of the regional-level teacher cost index (TCI)

State	Standard error regional-level teacher cost index
U.S.	0.8942
Alaska	2.1859
Alabama	0.6634
Arkansas	0.7210
Arizona	1.0890
California	1.0280
Colorado	1.0048
Connecticut	0.6997
District of Columbia	1.3238
Delaware	0.6935
Florida	0.9157
Georgia	0.9316
Hawaii	1.0024
Iowa	0.7898
Idaho	0.9844
Illinois	0.9156
Indiana	0.7372
Kansas	0.8286
Kentucky	0.6985
Louisiana	0.7365
Massachusetts	0.8647
Maryland	0.9107
Maine	1.1621
Michigan	0.9736
Minnesota	0.8966
Missouri	0.8066
Mississippi	0.6708
Montana	1.1544
North Carolina	0.7554
North Dakota	1.0819
Nebraska	0.8924
New Hampshire	0.9936
New Jersey	0.8699
New Mexico	0.8866
Nevada	1.0220
New York	1.3580
Ohio	0.6647
Oklahoma	0.7290
Oregon	0.9275
Pennsylvania	0.8465
Rhode Island	0.5639
South Carolina	0.6992
South Dakota	0.9341
Tennessee	0.6947
Texas	0.7952
Utah	0.8496
Virginia	0.8709
Vermont	1.0848
Washington	0.8644
Wisconsin	0.7593
West Virginia	0.8346
Wyoming	1.1857

SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table C.2— Standard Errors for table 4.1B: State-by-state estimates of the district-level teacher cost index (TCI)

State	Standard error for district-level teacher cost index
U.S.	1.2297
Alaska	2.4028
Alabama	0.9264
Arkansas	0.9288
Arizona	1.5347
California	1.7995
Colorado	1.1534
Connecticut	1.0341
District of Columbia	1.8192
Delaware	0.9108
Florida	1.0921
Georgia	1.0806
Hawaii	6.3608
Iowa	0.8899
Idaho	1.0873
Illinois	1.1951
Indiana	0.8909
Kansas	0.9466
Kentucky	0.8259
Louisiana	0.9345
Massachusetts	1.1544
Maryland	1.2968
Maine	1.1627
Michigan	1.2266
Minnesota	1.1207
Missouri	0.9825
Mississippi	0.9745
Montana	1.2734
North Carolina	0.9704
North Dakota	1.1599
Nebraska	1.0020
New Hampshire	1.0530
New Jersey	1.2653
New Mexico	1.4593
Nevada	1.1857
New York	1.5539
Ohio	0.9087
Oklahoma	1.0935
Oregon	1.1618
Pennsylvania	1.0290
Rhode Island	0.9081
South Carolina	0.9456
South Dakota	1.0255
Tennessee	1.0113
Texas	1.2810
Utah	1.0559
Virginia	1.0783
Vermont	1.1145
Washington	1.1657
Wisconsin	0.9272
West Virginia	0.8992
Wyoming	1.2371

SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table C.3— Standard Errors for table 4.2A: The regional-level teacher cost index broken down by region, per pupil revenue, metropolitan population, distance from the nearest central city, district size, type of city, and percentage of children living in poverty

Category	Standard error for regional-level teacher cost index
Region	
Northeast	1.0310
Midwest	0.8313
South	0.8005
West	1.0114
Pupil revenue	
Less than 4,000	0.7759
4,000-6,000	0.8706
6,000-8,000	1.0809
8,000-10,000	0.9567
More than 10,000	1.1608
Metro population	
Less than 5,000	1.4499
5,000-20,000	0.9503
20,000-50,000	0.8285
50,000-100,000	0.8554
100,000-500,000	0.7837
500,000-1,000,000	0.7793
More than 1,000,000	1.0013
Distance from central city	
Less than 10	0.8057
10-20	1.0266
20-40	0.8637
40-80	0.8422
80-160	1.1921
More than 160	1.6893
District enrollment	
Less than 500	1.0372
501-1,000	0.9382
1,001-5,000	0.8609
5,001-10,000	0.8177
10,001-25,000	0.8308
25,001-50,000	0.8187
50,001-100,000	0.9198
More than 100,000	1.1910
Type of city	
Large central city	1.0038
Mid-size central city	0.7951
Urban fringe of large city	0.9157
Urban fringe of mid-size city	0.8360
Large town	0.8628
Small town	0.8802
Rural	0.9408
% children in poverty	
Less than 10%	0.8664
10%-20%	0.8673
20%-40%	0.9408
More than 40%	0.9319

SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table C.4— Standard Errors for table 4.2B: The district-level teacher cost indexbroken down by region, per pupil revenue, metropolitan population, distance from the nearest central city, district size, type of city, and percentage of children living in poverty

Category	Standard error for district-level teacher cost index
Region	
Northeast	1.2642
Midwest	1.0411
South	1.0871
West	1.6413
Pupil revenue	
Less than 4,000	1.0407
4,000-6,000	1.2366
6,000-8,000	1.4095
8,000-10,000	1.2965
More than 10,000	1.4951
Metro population	
Less than 5,000	1.4146
5,000-20,000	1.0901
20,000-50,000	0.9504
50,000-100,000	1.0174
100,000-500,000	1.0562
500,000-1,000,000	1.2592
More than 1,000,000	1.4434
Distance from central city	
Less than 10	1.2758
10-20	1.3582
20-40	1.0880
40-80	1.0230
80-160	1.3720
More than 160	1.9891
District enrollment	
Less than 500	1.2596
501-1,000	1.2101
1,001-5,000	1.0296
5,001-10,000	1.1715
10,001-25,000	1.2386
25,001-50,000	1.2537
50,001-100,000	1.2961
More than 100,000	1.7746
Type of city	
LARGE CENTRAL CITY	1.4635
MID-SIZE CENTRAL CITY	1.1864
URBAN FRINGE OF LARGE CITY	1.3679
URBAN FRINGE OF MID-SIZE CITY	1.1198
LARGE TOWN	1.0390
SMALL TOWN	1.0613
RURAL	1.1162
% children in poverty	
Less than 10%	1.1223
10%-20%	1.1529
20%-40%	1.3232
More than 40%	1.7124

SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table C.5— Standard Errors for table 4.4: A comparison of the regional- and district-level teacher cost index and the Barro teacher cost index

State	Index values		
	Regional-Level TCI	District-Level TCI	Barro's Cost Index
ALASKA			
Metropolitan	1.8816	1.8481	0.7921
Nonmetropolitan	2.4301	2.8479	0.8802
ALABAMA			
Nonmetropolitan	0.6466	0.8650	0.5320
Metropolitan	0.6733	0.9625	0.5285
ARKANSAS			
Nonmetropolitan	0.7458	0.9069	0.3975
Metropolitan	0.6888	0.9572	0.4465
ARIZONA			
Nonmetropolitan	1.4216	2.0248	0.5622
Metropolitan	0.9659	1.3533	0.6394
CALIFORNIA			
Nonmetropolitan	1.1253	1.5014	0.7635
Riverside-San Bernardino	1.2022	1.6326	1.0037
Metropolitan	0.8409	1.4903	0.8009
Los Angeles-Long Beach	1.2469	2.1666	0.9547
San Jose	0.7841	2.0161	0.7327
Anaheim-Santa Ana	0.9974	1.8152	0.8724
San Francisco	1.0578	2.9710	1.0459
COLORADO			
Nonmetropolitan	1.1749	1.2475	0.5426
Metropolitan	0.8423	1.0463	0.6191
Denver	1.0452	1.1876	0.7231
CONNECTICUT			
Nonmetropolitan	0.9644	0.9844	0.9057
Metropolitan	0.6801	1.0377	1.0445
DISTRICT OF COLUMBIA			
Metropolitan	1.3238	1.8192	0.7753
DELAWARE			
Nonmetropolitan	0.7748	0.8475	0.6189
Metropolitan	0.6341	0.9569	0.6950
FLORIDA			
Nonmetropolitan	0.8665	1.0284	0.5529
Metropolitan	0.8747	1.0369	0.6342
Miami-Hialeah	1.1419	1.3948	0.8416
GEORGIA			
Nonmetropolitan	0.7217	0.9439	0.5925
Metropolitan	1.0560	1.1616	0.6368
HAWAII			
Metropolitan	1.0024	6.3608	0.7837
Nonmetropolitan	1.0024	6.3608	0.7837
IOWA			
Nonmetropolitan	0.8846	0.8734	0.4698
Metropolitan	0.6612	0.9122	0.6114

Note: Barro index is calculated (denominator is not 4.8, it is sum of nonmissing observation).
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table C.5— Standard Errors for table 4.4: A comparison of the regional- and district-level teacher cost index and the Barro teacher cost index—Continued

State	Index values		
	Regional-Level TCI	District-Level TCI	Barro's Cost Index
IDAHO			
Nonmetropolitan	1.0901	1.1618	0.4772
Metropolitan	0.5200	0.7601	0.5508
ILLINOIS			
Nonmetropolitan	0.8595	1.0075	0.4732
Metropolitan	0.7317	0.9721	0.5924
Chicago	1.0580	1.4167	0.7587
INDIANA			
Nonmetropolitan	0.8971	0.8233	0.5798
Metropolitan	0.6696	0.9195	0.6369
KANSAS			
Nonmetropolitan	0.9427	0.9740	0.5159
Metropolitan	0.7208	0.9206	0.5504
KENTUCKY			
Nonmetropolitan	0.7158	0.7885	0.6653
Metropolitan	0.6735	0.8796	0.6409
LOUISIANA			
Nonmetropolitan	0.6284	0.8468	0.4928
Metropolitan	0.7858	0.9746	0.5169
MASSACHUSETTS			
Nonmetropolitan	1.3803	1.3311	0.5742
Metropolitan	0.8434	1.1471	0.7151
MARYLAND			
Nonmetropolitan	0.9765	1.0749	0.9028
Metropolitan	0.9047	1.3169	0.7918
MAINE			
Nonmetropolitan	1.2346	1.2234	0.5678
Metropolitan	0.8696	0.9175	0.6030
MICHIGAN			
Nonmetropolitan	1.1420	1.1281	0.6396
Metropolitan	0.8707	1.0284	0.7399
Detroit	0.9936	1.4270	0.8625
MINNESOTA			
Nonmetropolitan	0.9794	0.9968	0.5846
Metropolitan	0.8513	1.1884	0.6764
MISSOURI			
Nonmetropolitan	0.7560	0.8151	0.4495
Metropolitan	0.8360	1.0796	0.6060
MISSISSIPPI			
Nonmetropolitan	0.6923	0.9902	0.5030
Metropolitan	0.6183	0.9359	0.4762
MONTANA			
Nonmetropolitan	1.2968	1.3801	0.4508
Metropolitan	0.6871	0.9234	0.5254

Note: Barro index is calculated (denominator is not 4.8, it is sum of nonmissing observation).
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table C.5— Standard Errors for table 4.4: A comparison of the regional- and district-level teacher cost index and the Barro teacher cost index—Continued

State	Index values		
	Regional-Level TCI	District-Level TCI	Barro's Cost Index
NORTH CAROLINA			
Nonmetropolitan	0.7497	0.9793	0.5669
Metropolitan	0.7606	0.9622	0.5260
NORTH DAKOTA			
Nonmetropolitan	1.2063	1.2219	0.4184
Metropolitan	0.8785	1.0586	0.4678
NEBRASKA			
Nonmetropolitan	1.1039	1.0621	0.4504
Metropolitan	0.6469	0.9322	0.5816
NEW HAMPSHIRE			
Nonmetropolitan	1.0743	1.0717	0.5559
Metropolitan	0.8780	1.0265	0.6543
NEW JERSEY			
Newark	0.8699	1.2653	0.7531
Metropolitan	0.8699	1.2653	0.7531
Nonmetropolitan	0.8699	1.2653	0.7531
NEW MEXICO			
Nonmetropolitan	0.9784	1.6371	0.5305
Metropolitan	0.7482	1.1912	0.5660
NEVADA			
Nonmetropolitan	1.3870	1.4150	0.6666
Metropolitan	0.9290	1.1273	0.7333
NEW YORK			
Nonmetropolitan	1.0814	1.0765	0.6797
Metropolitan	0.9331	1.0837	0.7934
New York	1.7569	2.0418	1.0578
Nassau-Suffolk	1.2290	1.4075	1.0973
OHIO			
Nonmetropolitan	0.7983	0.7225	0.6120
Metropolitan	0.6120	0.9139	0.6997
Cleveland	0.6962	1.1734	0.8013
OKLAHOMA			
Nonmetropolitan	0.7411	1.1660	0.4277
Metropolitan	0.7210	1.0464	0.4534
OREGON			
Nonmetropolitan	1.0744	1.1422	0.5202
Metropolitan	0.8525	1.1718	0.6386
PENNSYLVANIA			
Nonmetropolitan	0.8716	0.8196	0.6074
Metropolitan	0.7270	0.8633	0.6321
Pittsburgh	0.7557	1.0072	0.7550
Philadelphia	1.0326	1.4107	0.8726

Note: Barro index is calculated (denominator is not 4.8, it is sum of nonmissing observation).
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Table C.5— Standard Errors for table 4.4: A comparison of the regional- and district-level teacher cost index and the Barro teacher cost index—Continued

State	Index values		
	Regional-Level TCI	District-Level TCI	Barro's Cost Index
RHODE ISLAND			
Nonmetropolitan	0.9428	1.0555	0.8698
Metropolitan	0.5202	0.8911	0.7662
SOUTH CAROLINA			
Nonmetropolitan	0.6849	0.9474	0.6082
Metropolitan	0.7140	0.9439	0.5692
SOUTH DAKOTA			
Nonmetropolitan	0.9889	1.0535	0.4138
Metropolitan	0.6674	0.8892	0.4515
TENNESSEE			
Nonmetropolitan	0.6762	0.9363	0.5570
Metropolitan	0.7053	1.0545	0.6032
TEXAS			
Nonmetropolitan	0.8248	1.1775	0.4812
Metropolitan	0.7832	1.4083	0.5307
Houston	0.7896	1.1626	0.5921
Dallas	0.8023	1.1487	0.5934
UTAH			
Nonmetropolitan	1.0991	1.2586	0.4699
Metropolitan	0.7758	0.9960	0.5056
VIRGINIA			
Nonmetropolitan	0.8222	0.9132	0.6153
Metropolitan	0.8900	1.1429	0.6541
VERMONT			
Nonmetropolitan	1.1343	1.1510	0.5727
Metropolitan	0.8781	0.9634	0.6547
WASHINGTON			
Nonmetropolitan	0.9628	1.0828	0.6549
Metropolitan	0.8184	1.1003	0.7001
Seattle	0.8239	1.3019	0.7351
WISCONSIN			
Nonmetropolitan	0.8677	0.8641	0.5855
Metropolitan	0.7011	0.9611	0.6153
WEST VIRGINIA			
Nonmetropolitan	0.9006	0.9501	0.5008
Metropolitan	0.7080	0.8016	0.4968
WYOMING			
Nonmetropolitan	1.2566	1.2889	0.5293
Metropolitan	0.9887	1.0932	0.6075

Note: Barro index is calculated (denominator is not 4.8, it is sum of nonmissing observation).
SOURCE: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.